CHAPTER 11
EROSION AND SEDIMENT CONTROL

11.1 Purpose

This chapter describes requirements for the planning and implementation of non-structural and structural best management practices (BMPs) to be used for erosion and sediment control during construction activities in Fayette County, Kentucky. Erosion control refers to efforts to maintain soil on a construction site. Sediment control refers to keeping the material that erodes from leaving the site.

Sediment leaving a construction site results in the following adverse impacts to the stream environment:

- loss of habitat due to decreased light penetration
- decreases in channel capacity
- decreases in reservoir storage capacity

Non-structural practices, which are primarily avoidance practices, and structural practices, which require construction, are described in this chapter. A construction site will require the implementation of both types of practices. Details on the structural practices are given in Sections 11.4 and 11.5 of this manual.

11.1.1 Regulatory Basis

Erosion and sediment control on a construction site are regulated by the Kentucky Pollutant Discharge Elimination System (KPDES) General Permit for Stormwater Point Sources (Construction) and by Article 20 of the Lexington-Fayette Urban County Government (LFUCG) Zoning Ordinance. The KPDES General Permit requires, among other things:

- the submission of a Notice of Intent to the Kentucky Division of Water before construction begins
- the preparation of a stormwater best management practices plan, which includes an erosion and sediment control plan, to be kept on-site at all times
- a description of procedures to maintain erosion and sediment control measures during the life of construction
- the inspection by qualified personnel of the site at least once every seven calendar days and within 24 hours of the end of a storm of 0.5 inch or greater
- the identification of each contractor or subcontractor who will install each erosion and sediment control measure
- the signing by each contractor or subcontractor of a statement certifying their awareness of the requirements of the KPDES Stormwater Permit for the site
- the submission of a Notice of Termination to the Kentucky Division of Water, at the end of the project, which certifies that all stormwater discharges associated with the construction activity have been eliminated

11.2 Requirements

This section lists the erosion and sediment control requirements.

11.2.1 Erosion and Sediment Control Plan

The preparation of an erosion and sediment control plan integrating the non-structural and structural practices and procedures of this chapter is a requirement for all construction projects that disturb one acre or more. The plan shall be submitted to the LFUCG Division of Engineering before beginning construction. Once the erosion and sediment control practices have been constructed, a grading permit can be obtained. For more information on permits, see Chapter 2 of this manual. More detail on the preparation of the Erosion and Sediment Control Plan is found in Section 11.3 of this manual.

Land disturbances for the construction of a structure on a single residential lot are permitted through the building permit process and must comply with the requirements of Section 11.6 of this manual.

11.2.2 Non-Structural Practices

This section describes the planning and implementation of the required non-structural BMPs to minimize erosion and off-site sedimentation.

These BMPs include

- floodplain avoidance
- stream buffer zones
- reduced exposure time
- limits on maximum disturbed area
- embankment slope minimization

Floodplain Avoidance
No construction or grading activities are permitted in the post-development floodplains, as defined in Chapter 1 of this manual, except for road and utility crossings and permanent stormwater management facilities. Therefore, only erosion and sediment control practices related to allowable construction activities shall be permitted in the post-development floodplain. Temporary sediment control in a permanent pond shall be allowed in the post-development floodplain but not in a stream.

Vegetative Buffer Strips
Buffer strips are required adjacent to all streams and wetlands in Fayette County. The buffer strip width shall be 25 feet from the top of each bank and from the edge of a wetland. No grading or land clearing is allowed within the buffer zone, and native vegetation must be preserved.

Reduced Exposure Time
All on-site measures required by the Erosion and Sediment Control Plan shall be made functional before other land disturbance takes place. Permanent or temporary soil stabilization, as described under structural practices, shall be applied to disturbed or constructed areas within 14 days after final grade is reached. Soil stabilization shall also be applied to all disturbed areas not at final grade, including soil stockpiles, dams, dikes, and diversions, which have been inactive for 14 days.

Limits on Maximum Disturbed Area
The maximum area that may be disturbed at any time during construction, without soil stabilization, is 25 acres. For sites over 25 acres in size, additional land can be disturbed only when an equal amount of land is stabilized. A construction site shall not be broken into individual permits to avoid this requirement.

Embankment Slope Minimization
Steep embankment slopes present increased opportunities for erosion and sediment production due to high runoff velocities. To minimize adverse effects of steep embankment slopes, constructed fill slopes and cut slopes shall not be steeper than 3H:1V. For slopes of 4H:1V or steeper with slope lengths of greater than 100 feet, temporary diversion ditches shall be constructed at the top of the slope and every 100 feet horizontally down the slope.

11.2.3 Structural Practices for Soil Stabilization

This section describes the planning and implementation of the required structural BMPs to minimize erosion and off-site sedimentation through the stabilization of soil materials.

The BMPs include:

- mulch
- temporary seed
- permanent seed
- sod
- road/parking stabilization
- construction entrance
- dust control
- nets and mats
- gabion mattress
- temporary diversion ditch
- level spreader
- permanent constructed waterway
- pipe slope drain
- impact stilling basin

Mulch
Mulch shall be used as a soil stabilization measure for any disturbed area inactive for 14 days or longer. Areas requiring stabilization during December through February shall receive

only mulch held in place with bituminous material. Mulching shall be used whenever permanent or temporary seeding is used. The anchoring of mulch shall be in accordance with Figure 11-1 except all mulch placed in December through February shall be anchored with bituminous materials regardless of the slope.

Permanent mulches shall be used in conjunction with planting trees, shrubs, and other ground covers that do not provide adequate soil stabilization.

Temporary Seed

Temporary seeding shall be used for soil stabilization when grades are not ready for permanent seeding, except during December through February. The seed shall be applied within 14 days after grading has stopped. Only rye grain or annual rye grass seed shall be used for temporary seeding. The use of mulch and erosion matting and netting with temporary seeding shall be in accordance with Figure 11-1.

Permanent Seed

Permanent seeding shall be applied within 14 days after final grade has been reached, except during December through February. Permanent seeding shall also be applied on any areas that will not be disturbed again for a year even if final grades have not been reached. The use of mulch and erosion matting and netting with permanent seeding shall be in accordance with Figure 11-1. "Seed mats" may be used for permanent seeding in accordance with manufacturers' recommendations.

Sod

Sod shall be used for disturbed areas that require immediate vegetative cover, e.g. the area surrounding a drop inlet in a grassed waterway, the design flow perimeter of a grassed waterway that will convey flow before vegetation can be established, and the inlet of a culvert. Sod may be installed throughout the year. "Seed mats" and seed with geotextiles may be used in place of sod when done in accordance with manufacturers' recommendations.

Road/Parking Stabilization

Gravel or paved material shall be used to stabilize permanent roads or parking areas or roads or parking areas used repeatedly by construction traffic. Stabilization shall be accomplished within 14 days of grading or initiation of use for construction traffic. Unstabilized roads are not acceptable except in instances where the road will be used less than one month.

Construction Entrance

A stabilized construction entrance shall be constructed wherever vehicles are leaving a construction site to enter a public road or at any unpaved entrance/exit location where there is a risk of transporting mud or sediment onto paved roads. A construction entrance shall be constructed at the beginning of the project before construction traffic begins to enter and exit the site.

Dust Control

Dust control measures shall be implemented on all sites.

Nets and Mats
Mulch netting, erosion control matting, or turf reinforcement matting (TRM) shall be used on sloping areas as indicated in Figure 11-1. Mats or nets and permanent seeding may be used as an alternate to sod for culvert entrances and grassed waterways. TRMs shall be used at the water line to control wave action in wet ponds. TRMs shall be used in accordance with manufacturer's recommendations.

Gabion Mattress
Gabion mattresses shall be used at the outlets of all culverts and storm drains with an exit velocity greater than 5 feet per second when flowing full, except where there are paved ditches. Gabion mattresses shall also be used at the outlet of impact stilling basins.

Temporary Diversion Ditch
Temporary diversion ditches shall be used to collect sediment-laden runoff from disturbed areas and direct it to a sediment pond where applicable. Temporary ditches are those expected to be in use for less than one year. Temporary diversion ditches do not require stabilization.

Level Spreader
Level spreaders shall be constructed at the outlets of temporary diversion ditches. Level spreaders shall also be constructed at outlets of permanent constructed waterways where they terminate on undisturbed areas.

Permanent Constructed Waterway
Permanent constructed waterways shall be used to divert stormwater runoff from upland undisturbed areas around or away from areas to be disturbed during construction. A waterway expected to be in place for at least one year shall be considered permanent. Permanent waterways shall be lined with sod or permanent seeding and nets, mats, or TRMs. Design permanent constructed waterways in accordance with procedures and criteria given in Chapter 8.

Pipe Slope Drain
Pipe slope drains shall be used whenever it is necessary to convey water down a steep slope, which is not stabilized or which is prone to erosion, unless paved ditch (flume) is installed.

Impact Stilling Basin
Impact stilling basins shall be used at the outlet of culverts and storm sewers with calculated exit velocities greater than 15 feet per second when flowing full.

11.2.4 Structural Practices for Sediment Control

This section describes when and where specific structural sediment control practices are required. The practices include:

- check dam
- sediment trap

- sediment pond
- silt fence
- storm drain inlet protection
- filter strip
- stream crossing
- pump-around flow diversion
- construction dewatering

Check Dam
Check dams shall be installed in newly-constructed, vegetated, open channels, which drain 10 acres or less. Check dams shall be constructed prior to the establishment of vegetation.

Sediment Trap
Sediment traps shall be installed below all disturbed areas of less than 5 acres that do not drain to a sediment pond.

Sediment Pond
A sediment pond shall be installed at the outlet of a disturbed area of 5 acres or more. The maximum drainage area for a single pond is 100 acres. The pond shall be designed to reduce peak discharges during construction to pre-development levels for 10-year and 100-year storms.

Silt Fence
Silt fence shall be installed down-slope of areas to be disturbed prior to clearing and grading. Silt fence must be situated such that the total area draining to the fence is not greater than one-fourth acre per 100 feet of fence. Silt fence shall be used for storm drain drop inlet protection and around soil stockpiles.

Storm Drain Inlet Protection
Storm drain inlet protection shall only be used around drop inlets when the up-slope area draining to the inlet has no other sediment control.

Filter Strip
Filter strips shall be used on each side of permanent constructed channels. The buffer strips described in Section 11.2.2 satisfy the filter strip requirement for streams and wetlands.

Stream Crossing
Stream crossings shall be used in cases where construction traffic, permanent traffic, or utilities must cross existing post development floodplains. If the drainage area exceeds 1 square mile and a structure is necessary, the structure must be designed by a professional engineer licensed in Kentucky. If applicable, U.S. Army Corps of Engineers and the Kentucky Division of Water permits, as indicated in Chapter 2 of this manual, may be required.

Pump-Around Flow Diversion
A pump-around flow diversion shall be used to divert flow around construction activities occurring in a stream when those activities are reasonably expected to cause the erosion or deposition of sediment in the stream.

Construction Dewatering
Sediment-laden water must be pumped to a dewatering structure before it is discharged offsite.

Concrete Washout Pits
Concrete washout pits shall be constructed and maintained by the Developer throughout the home building phase of residential development projects. A minimum of one pit per 40 lots shall be constructed prior to plat recording.

11.3 Erosion and Sediment Control Plans

An erosion and sediment control plan shall be submitted to LFUCG before construction commences for any disturbed area other than the construction of a single family, two family, or townhouse residence. The plan shall be developed and signed by a professional engineer or landscape architect licensed in Kentucky. All hydrologic, hydraulic, structural, and geotechnical design work included in the plan must be done and signed by a professional engineer licensed in Kentucky. The plan shall include the topics described in the following sub-sections.

The erosion control requirements for individual lots are covered in Section 11.6.

11.3.1 Written Description

The erosion and sediment control plan must contain a written description that shall include, at a minimum:

- a discussion of the land-disturbing project including the purpose, location, and size of area to be disturbed
- a discussion of the topography, land cover condition, soils, percent of impervious area, and drainage patterns both before and after development
- an identification of land use and cover conditions on adjacent property;
- the beginning and completion dates of construction activities
- a discussion of construction sequencing, including clearing, grading, and revegetation activities as well as winter shut downs
- a listing of erosion and sediment control BMPs, along with location, installation schedule, and the logic for each
- a listing of stormwater pollution control and groundwater protection BMPs to minimize pollution during construction (other than erosion) that might result from construction activities (for example, gasoline or diesel spilled while refueling construction vehicles)

11.3.2 Site Map

The erosion and sediment control plan must contain a site map showing:

- current topography from field surveys or aerial photography at a scale of 1”=50’ with 2-foot contours showing pre-construction topography, drainage ways, property lines, utilities, limits of construction, and trees to be preserved
- finished grades, building locations, paved areas, construction entrances, access or haul roads, stockpile areas and equipment storage areas overlaid on the site topographic map
- all planned BMPs overlaid on the other features
- areas that are not to be disturbed

11.3.3 Drawings and Specifications

Drawings and specifications of the BMPs shall be included in the plan.

11.3.4 Design Calculations

All hydrologic, hydraulic, structural, and geotechnical design calculations shall be included in the plan.

11.3.5 O&M Plan

An operation and maintenance (O & M) plan shall be developed which provides a schedule for inspection, maintenance, and repair of BMPs during construction activities. A maintenance schedule shall also be provided to ensure that permanent measures such as vegetation are properly established after construction is complete.

11.3.6 Responsible Parties/Construction Supervisor

The name, address, and telephone number of the parties responsible for implementing the plan shall be included in the plan. The name of the construction supervisor who will be on-site during construction shall be included in the plan.

An on-site construction progress meeting to review erosion prevention and sediment control measures shall be held once the pipe crews have installed the pipe work. The meeting shall be attended by appropriate LFUCG staff, the Engineer, and Contractor.

The construction supervisor shall ensure that orange safety fence is placed around each storm sewer manhole and sanitary sewer manhole prior to plat recording to minimize the risk of accidental damage to the manholes. The safety fence may be removed after permanent seeding and sodding has been completed.

11.3.7 Education/Training

The education and training requirements for implementation of the plan shall be accomplished by the Engineer, who shall provide for initial training and continuing education for all construction employees and subcontractors of the contractor to inform them of the plan requirements. As work progresses and various subcontractors and/or new employees are brought onto the work site, each should be familiarized by the Engineer with the plan. At the beginning of each workweek, scheduled items of the plan to be implemented during that week should be brought to the attention of the impacted work force.

11.4 Structural Soil Stabilization BMPs

11.4.1 Mulch

Spreading mulch is a temporary soil stabilization or erosion control practice where materials such as straw, wood chips, wood fibers, or rock are placed on the soil surface. Mulching prevents erosion by protecting the soil surface from raindrop impact and by reducing the velocity of overland flow. Mulch can also be used for dust control.

When used with temporary or permanent seeding, mulch can aid in plant growth by holding the seeds, fertilizers, and topsoil in place, by helping to retain moisture, and by insulating against extreme temperatures. Mulch can also improve the aesthetics of the site. Organic mulch materials such as straw, wood chips, bark, recycled paper, and wood fiber are the most effective mulches.

Design Criteria
Straw is the mulch most commonly used in conjunction with seeding. The recommended straw should come from wheat, rye, or barley and may be spread by hand or machine. Straw shall be anchored.

Wood chips are suitable for areas that will not be closely mowed, and around ornamental plantings. Chips decompose slowly and do not require tacking. Wood chips should be treated with 12 pounds slow-release nitrogen per ton to prevent nutrient deficiency in plants.

Bark chips and shredded bark are used in landscaped plantings. Bark is also suitable mulch for areas planted to grasses and not closely mowed. Bark is not usually toxic to grasses or legumes, and additional nitrogen fertilizer is not required.

Manufactured wood fiber and recycled paper sold as mulch materials are usually marketed to apply in a hydroseeder slurry with binder/tackifiers. Manufacturer's recommendations shall be followed during application.

A wide range of synthetic, spray-on materials is marketed to stabilize and protect the soil surface. These are emulsions or dispersions of vinyl compounds, asphalt, rubber, or other substances that are mixed with water and applied to the soil. They may be used to tack wood fiber hydromulches or straw, and they usually decompose in 60 to 90 days.

A variety of mulch nets and mats are available to use as mulching or to hold mulch in place. Netting and mats shall be used in critical areas such as waterways where concentrated flows are expected. Netting can help retain soil moisture or modify temperature. It stabilizes the soil surface while grasses are being established and is particularly useful in grassed waterways and on slopes. Lightweight netting may also be used to hold other mulches in place. Netting and erosion control mats shall be used in accordance with Figure 11-1.

Gravel or crushed stone can be used to provide a long-term protection against erosion, particularly on short slopes. Before the gravel or crushed stone is applied, it should be

washed. Aggregate cover shall only be used in relatively small areas and shall be incorporated into an overall landscaping plan.

Material Specifications

Straw shall be applied at two tons per acre or 90 pounds per 1,000 square feet. Straw shall be free from weeds and coarse matter.

Wood chips shall be applied at 400 cubic yards per acre or 9 cubic yards per 1000 square feet and approximately 3 inches deep. Wood chips shall be treated with 12 pounds of nitrogen per ton.

Recycled paper (newsprint) or wood fiber shall be mixed at 50 pounds per 100 gallons of water and applied according to manufacturer's recommendations and model of hydroseeder in use.

Bark chips or shredded bark shall be applied at 70 cubic yards per acre or 1.5 to 2 cubic yards per 1000 square feet and about one-half inch thick.

Liquid mulch binders/tackifiers may be asphalt, synthetic, or wood fiber slurries applied according to manufacturer's recommendations.

Chemical soil stabilizers or soil binders/tackifiers/emulsions shall not be used alone. These materials are useful to bind organic mulches together.

Construction Specifications

Seed shall be applied prior to mulching except where seed is to be applied as part of a hydroseeder slurry containing mulch.

Lime and fertilizer shall be incorporated and surface roughening accomplished as needed prior to mulching in accordance with applicable sections of this manual.

Mulch materials shall be spread uniformly by hand or machine.

Mulch shall be anchored during or immediately after spreading to prevent being blown by the wind. Mulch may be anchored using a mulch anchoring tool, a liquid binder/tackifier, or mulch nettings. Nets and mats shall be installed to obtain firm, continuous contact between the material and the soil. Without such contact, the material is useless and erosion occurs.

A mulch anchoring tool is a tractor-drawn implement that is typically used for anchoring straw and is designed to punch mulch approximately two inches into the soil surface. Machinery shall be operated on the contour and shall not be used on slopes steeper than 3H:1V.

When using liquid mulch binders and tackifiers, application shall be heaviest around edges of areas and at crests of ridges and banks to prevent wind blow. Remainder of area shall have binders/tackifiers spread uniformly in accordance with manufacturer's recommendations.

When using a mulch net, it shall be used in conjunction with an organic mulch and shall be installed immediately after the application and spreading of the mulch. Mulch net shall be installed over the mulch except when the mulch manufacturer recommends otherwise.

Excelsior blankets and mats with mulch are considered protective mulches and may be used alone on erodible soils and during all times of year. Erosion control mats shall be installed in accordance with manufacturer's recommendations.

Maintenance
Mulched areas shall be inspected at least weekly and after every rainfall of one-half inch or more. When mulch material is found to be loosened or removed, the mulch cover shall be replaced within 48 hours.

11.4.2 Temporary Seed

Temporary seeding stabilizes disturbed areas by the establishment of a temporary vegetative cover of rapidly growing plants on disturbed areas that are not at final grade. Temporary seeding reduces problems associated with mud or dust from bare soil surfaces during construction, reduces erosion and sediment runoff to downstream areas and/or groundwater basins, and improves the visual appearance of the construction area.

Seed, fertilizer, and mulch specifications are listed in the KY Erosion Prevention and Sediment Control Field Guide.

Construction Specifications
The site shall be graded as needed to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, and anchoring.

The needed erosion control practices shall be installed prior to seeding such as diversions, temporary waterways for diversion outlets, and sediment ponds.

Prior to seeding, work the lime and fertilizer into the soil with a disk harrow, springtooth harrow, or similar tools to a depth of two inches. On sloping areas, the final operation shall be on the contour.

The seed shall be applied uniformly with a cyclone seeder, drill, cultipacker, seeder, or hydroseeder (slurry may include seed and fertilizer) preferably on a firm, moist seedbed. Seed no deeper than one-fourth inch to one-half inch.

When feasible, except where a cultipacker type seeder is used, the seedbed shall be firmed following seeding operations with a cultipacker, roller, or light drag. On sloping land, seeding operations shall be on the contour wherever possible.

Mulch shall be applied, in the amounts described in the mulch practice in this chapter, to protect the soil and provide a better environment for plant growth.

The mulch shall be spread uniformly by hand or mechanically so the soil surface is covered. Following application, the mulch shall be anchored or otherwise secured to the ground according to one of the following methods:

- Mechanical – Use a disk, crimper, or similar type tool set straight to punch or anchor the mulch material into the soil.
- Mulch Tackifiers/Nettings/Emulsions – Use according to the manufacturer's recommendations. This is a superior method in areas of water concentration to hold mulch in place.
- Wood Fiber – Wood fiber hydroseeder slurries may be used to tack straw mulch. This combination treatment is well suited to steep slopes and critical areas, and severe climate conditions.

For more information on mulch application see Section 11.4.1– Mulch.

Maintenance

New seed shall have adequate water for growth, through either natural means or irrigation, until plants are firmly established.

Seeded areas shall be inspected every two weeks after planting and after each rainfall of 0.5 inches or more. Areas requiring additional seed and mulch shall be repaired within 48 hours. If vegetative cover is not established within 21 days, the area shall be reseeded.

11.4.3 Permanent Seed

Permanent seeding is the stabilization of disturbed areas with the establishment of permanent vegetation by planting seed. The primary purpose of permanent seeding is to permanently stabilize disturbed areas in a manner that is economical, adaptable to site conditions, and allows selection of the most appropriate plant materials. Permanent seeding also reduces the erosion and sediment yield from disturbed areas while the vegetation is becoming established.

Design Criteria

Permanent seeding shall be used on disturbed areas where permanent, long-lived vegetative cover is needed to stabilize the soil and on rough graded areas that will not be brought to final grade for one year or more.

The area to be seeded shall be protected from excess runoff as necessary with diversions, grassed waterways, terraces, or sediment ponds.

Plant species shall be selected on the basis of timing of establishment, planned use of the area, and the amount or degree of maintenance that can be devoted to the area in the future.

Vegetative cover alone shall not be used to provide erosion control cover and prevent soil slippage on a soil that is not stable due to its structure, water movement, or excessive slope.

Material Specifications

Seed shall be applied in a mixture based upon the season and ultimate use of the site. Erosion and sediment control plans submitted to LFUCG shall include seed mixtures, rates, and planting dates selected for permanent seeding. Permanent seeding may be done at any time except December through February. Seed, fertilizer, and mulch specifications are listed in the KY Erosion Prevention and Sediment Control Field Guide.

Soil material shall be capable of supporting permanent vegetation and have at least 25 percent silt and clay to provide an adequate amount of moisture holding capacity. An excessive amount of sand will not consistently provide sufficient moisture for good growth regardless of other soil factors.

Construction Specifications

During site preparation, topsoil shall be stockpiled for use in establishing permanent vegetation.

The site shall be graded as needed to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, and anchoring.

The needed erosion control practices shall be installed prior to seeding such as diversions, temporary waterways for diversion outlets, and sediment ponds.

Prior to seeding, work the lime and fertilizer into the soil with a disk harrow, springtooth harrow, or similar tools to a depth of four inches. On sloping areas, the final operation shall be on the contour.

Where compacted soils occur, they should be broken up sufficiently to create a favorable rooting depth of six to eight inches.

The seed shall be applied uniformly with a cyclone seeder, drill, cultipacker, seeder, or hydroseeder (slurry may include seed and fertilizer) preferably on a firm, moist seedbed. Seed no deeper than one-fourth inch to one-half inch.

When feasible, except where a cultipacker type seeder is used, the seedbed shall be firmed following seeding operations with a cultipacker, roller, or light drag.

On sloping land, seeding operations shall be on the contour wherever possible.

Mulch shall be applied to protect the soil and provide a better environment for plant growth.

The mulch shall be spread uniformly by hand or mechanically so the soil surface is covered. Following application, the mulch shall be anchored or otherwise secured to the ground according to one of the following methods:

- Mechanical – Use a disk, crimper, or similar type tool set straight to punch or anchor the mulch material into the soil.
- Mulch Tackifiers/Nettings/Emulsions – Use according to the manufacturer's recommendations. This is a superior method in areas of water concentration to hold mulch in place.
- Wood Fiber – Wood fiber hydroseeder slurries may be used to tack straw mulch. This combination treatment is well suited to steep slopes and critical areas, and severe climate conditions.

For more detailed information on mulch application, see Section 11.4.1- Mulch.

Maintenance
New seed shall have adequate water for growth, through either natural means or irrigation, until plants are firmly established.

Seeded areas shall be inspected every two weeks after planting and after each rainfall of 0.5 inches or more. Areas requiring additional seed and mulch shall be repaired within 48 hours. If vegetative cover is not established within 21 days, the area shall be reseeded. If less than 85 percent groundcover is established, seed and fertilize, using half of rates originally applied, and mulch. If less than 40 percent groundcover occurs, follow original seedbed preparation methods, seeding and mulching recommendations, and apply lime and fertilizer as needed according to soil tests.

11.4.4 Sod

Sod is used to stabilize fine-graded disturbed areas by establishing permanent grass stands. Sod has several purposes or applications including:

- establishment of permanent turf immediately
- prevention of erosion and damage from sediment and runoff by stabilization of the soil surface
- reduction of dust and mud associated with bare soil surfaces
- stabilization of drainageways where concentrated overland flow will occur

Design Criteria
Sodding shall be used for disturbed areas that require immediate vegetative cover. Locations particularly suited to stabilization with sod include waterways carrying intermittent flow and the area around drop inlets in grassed waterways.

The species of sod selected shall be based on soil type, planned use of the area, and the amount of maintenance that can be devoted to the area in the future.

Sod shall not be used to provide erosion control and prevent soil slippage on a soil that is not stable due to its structure, water movement, or excessive slope.

Material Specifications

Soil material shall be capable of supporting permanent vegetation and shall consist of at least 25 percent silt and clay to provide an adequate amount of moisture holding capacity. An excessive amount of sand will not consistently provide sufficient moisture for the sod regardless of other soil factors.

Fertilizer shall be applied at a rate of 1,200 pounds per acre of 10-10-10 analysis or equivalent, unless soil test results indicate a different rate is appropriate. Lime shall be applied at a rate of 100 pounds per 1000 square feet or two tons per acre of agricultural ground limestone, unless soil test results indicate differently.

The sod shall consist of strips of live, vigorously growing grasses. The sod shall be free of noxious and secondary noxious weeds and shall be obtained from good, solid, thick-growing stands. The sod shall be cut and transferred to the job in the largest continuous pieces that will hold together and are practical to handle.

The sod shall be cut with smooth clean edges and square ends to facilitate laying and fitting. The sod shall be cut to a uniform thickness of not less than three-fourth inch measured from the crown of the plants to the bottom of the sod strips for all grasses except bluegrass. Bluegrass sod shall be cut to a uniform thickness of not less than one and one-half inches.

The sod shall be mowed to a height of not less than two inches and no more than four inches prior to cutting.

The sod shall be kept moist and covered during hauling and preparation for placement on the sodbed.

Construction Specifications

The area to be sodded shall be protected from excess runoff, as necessary, with appropriate BMPs.

Lime and fertilizer shall be worked into the soil with a disk harrow, springtooth harrow, or other suitable field equipment to a depth of four inches.

Prior to sodding, the soil surface shall be cleared of all trash, debris, and stones larger than one and one-half inches in diameter, and of all roots, brush, wire, and other objects that would interfere with the placing of the sod.

Compacted soils must be broken up sufficiently to create a favorable rooting depth of six to eight inches.

After the lime and fertilizer have been applied and just prior to the laying of the sod, the soil in the area to be sodded shall be loosened to a depth of one inch. The soil shall be thoroughly dampened immediately after the sod is laid if it is not already in a moist condition.

No sod shall be placed when the temperature is below 32^{o}F. No frozen sod shall be placed nor shall any sod be placed on frozen soil.

When sod is placed during the periods of June 15 to September 1 or October 15 to March 1, it shall be covered immediately with a uniform layer of straw mulch approximately one-half inch thick or so the green sod is barely visible through the mulch.

Sod shall be carefully placed and pressed together so it will be continuous without any voids between the pieces. Joints between the ends of strips shall be staggered.

On gutter and channel sodding, the sod should be carefully placed on rows or strips at right angles to the centerline of the channel (i.e., at right angles to the direction of flow). The edge of the sod at the outer edges of all gutters shall be sufficiently deep so that surface water will flow over onto the top of the sod.

On steep graded channels, each strip of sod shall be staked with at least two stakes not more than 18 inches apart.

Sod shall be tamped or rolled after placing and then watered. Watering shall consist of a thorough soaking of the sod and of the sodbed to a depth of at least 4 inches. The sod should be maintained in a moist condition by watering for a period of 30 days.

On slopes 3H:1V or steeper, or where drainage into a sod gutter or channel is one-half acre or larger, the sod shall be rolled or tamped and then chicken wire, jute, or other netting pegged over the sod for protection in the critical areas. The netting and sod shall be staked with at least two stakes not more than 18 inches apart. The netting shall be stapled on the side of each stake within two inches of the top of the stake. The stake should then be driven flush with the top of the sod.

When stakes are required, the stakes shall be wood and shall be approximately ½ inch by ¾ inch by 12 inches. They shall be driven flush with the top of the sod with the flat side against the slope and on an angle toward the slope.

Maintenance

In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week to maintain moist soil to a depth of 4 inches. Watering shall be done during the heat of the day to prevent wilting. After the first week, sod shall be watered as necessary to maintain adequate moisture content.

The first mowing of sod shall not be attempted until the sod is firmly rooted. No more than one-third of the grass leaf shall be removed by the initial and subsequent cuttings. Grass height shall be maintained between 2 inches and 3 inches.

Where sod does not establish properly, the sod should be replaced immediately. Areas requiring resodding should be prepared in the same manner as the original installation.

11.4.5 Road/Parking Stabilization

Road/parking stabilization refers to the stabilization of access roads, subdivision roads, parking areas, and other on-site vehicle routes with stone immediately after grading. The primary purpose of road/parking stabilization is to reduce erosion from roadbeds caused by construction traffic during wet weather. Stabilization also reduces regrading needed for permanent roadbeds by reducing erosion between the time of initial grading and final stabilization.

Design Criteria

Road/parking stabilization shall be used wherever roads or parking areas are constructed, whether permanent or temporary, for use by construction traffic.

Stabilization shall be accomplished with a minimum depth of six inches of crushed stone. Stabilized construction roadbeds shall be at least 14 feet wide for one-way traffic and at least 20 feet wide for two-way traffic. Figure 11-2 illustrates road/parking stabilization.

Temporary roads shall follow the contour of the natural terrain to the extent possible. Slopes shall not exceed 10 percent.

Temporary parking areas shall be located on naturally flat areas to minimize grading. Grades shall be sufficient to provide drainage but shall not exceed 4 percent.

All cuts and fills shall be 2H:1V or flatter.

Drainage ditches shall be provided as needed.

Material Specifications

Crushed stone shall be KYTC aggregate No. 2 (1.5 to 3 inches in diameter), or equivalent.

Construction Specifications

The roadbed or parking surface shall be cleared of all vegetation, roots, and other objectionable material.

All roadside ditches, cuts, fills, and disturbed areas adjacent to parking areas and roads shall be stabilized with appropriate temporary or permanent vegetation according to the applicable standards and specifications contained in this manual.

Geotextile filter fabric may be applied beneath the stone for additional stability in accordance with fabric manufacturer's specifications.

Both temporary and permanent roads and parking areas may require periodic top dressing with new gravel. Seeded areas adjacent to the roads and parking areas shall be checked regularly to ensure that a vigorous stand of vegetation is maintained. Roadside ditches and other drainage structures shall be checked once each week to ensure that they do not have silt or other debris that reduces their effectiveness.

11.4.6 Construction Entrance

A stabilized construction entrance is a portion of the construction road that is constructed with filter fabric and large stone. The primary purpose of a stabilized construction entrance is to reduce the amount of soil tracked off of the construction site by vehicles leaving the site. The stabilized entrance will also reduce erosion and rutting on that portion of the road where it is installed.

Design Criteria
A stabilized construction entrance shall be constructed in the following locations:

- wherever vehicles are leaving a construction site and enter onto a public road
- at any unpaved entrance/exit location where there is risk of transporting mud or sediment onto paved roads

A stabilized construction entrance shall be constructed of crushed stone a minimum of 6 inches thick laid over geotextile (filter fabric).

The width shall be at least 20 feet and as wide as the entire width of the access. At sites where traffic volume is high, the entrance shall be wide enough for two vehicles to pass safely. The length shall be at least 50 feet, and where practical, shall be extended to 100 feet. The entrance shall be flared where it meets the existing road to provide a turning radius. A standard drawing for a stabilized construction entrance is provided in Figure 11-3, with notes provided in Figure 11-4.

Stormwater and wash water runoff from a stabilized construction entrance shall drain to a sediment trap or sediment pond. If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the gravel, then the tires of the vehicles shall be washed before entering a public road.

Pipe placed under the entrance to handle runoff shall be protected with a mountable berm.

Dust control shall be provided in accordance with Section 11.2.3 and 11.4.7.

Material Specifications
Crushed stone shall be KYTC aggregate No. 2 (1.5 to 3 inches in diameter), or equivalent.

Geotextile filter fabric shall be KYTC Type III.

Construction Specifications
Vegetation, roots, and all other obstructions shall be cleared in preparation for grading. Prior to placing geotextile (filter fabric), the entrance shall be graded and compacted to 80% of standard proctor density.

To reduce maintenance and loss of aggregate, the geotextile shall be placed over the existing ground before placing the stone for the entrance. Stone shall be placed to depth of 6 inches or greater for the entire width and length of the stabilized construction entrance.

If wash racks are used, they shall be installed according to manufacturer's specifications.

Maintenance
The stabilized construction entrance shall be inspected once each week and after there has been a high volume of traffic or a storm event greater than 0.2 inches.

The entrance shall be maintained in a condition that will prevent tracking or flow of sediments onto public rights-of-way. This may require periodic top dressing with additional stone, as conditions demand, and repair and/or cleanout of any structures used to trap sediment.

All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately.

11.4.7 Dust Control

Dust control is the reducing of surface and air movement of dust during land disturbing, demolition and other construction activities. The purpose of dust control is to prevent the air movement of sediments to off-site areas or other on-site areas without sediment control where they could subsequently be washed into surface waters. Dust control shall be planned in association with earthmoving/site grading activities and areas with frequent construction traffic.

Design Criteria
Construction activities shall be phased to minimize the total area unstabilized at any given time, thereby reducing erosion due to air and water movement. Plans submitted to LFUCG shall illustrate construction phasing and describe dust and erosion control measures to be implemented at each phase.

Construction roads shall be watered as needed to minimize dust.

Existing trees, shrubs, and ground cover shall be retained as long as possible during the construction. Initial land clearing should be conducted only in those areas to be regraded or where construction is to occur. Areas to be cleared only for new vegetation or landscaping shall be stabilized with seed and mulch immediately following clearing.

Vegetative cover is the most effective means of dust and erosion control, when appropriate. See sections on Temporary Seed, Permanent Seed, Mulch, and Sod in this manual.

When areas have been regraded and brought to final grade, they shall be stabilized using temporary or permanent seed and mulch or other measures.

Mulch with mulch binders may be used as an interim dust control measure in areas where vegetation may not be appropriate.

Material Specifications
See sections on Temporary Seed, Permanent Seed, Sod, Mulch, Construction Road/Parking Stabilization, and Construction Entrance.

Construction Specifications
See sections referenced in Material Specifications above.

When construction is active on the site, dust control shall be implemented as needed.

When using tillage as a dust control measure, begin plowing on windward side of area. Chisel-type plows spaced about 12 inches apart, spring-toothed harrow, and similar plows are examples of equipment that may produce the desired effect.

Maintenance
The site shall be observed daily for evidence of windblown dust and reasonable steps shall be taken to reduce dust whenever possible. When construction on a site is inactive for a period, the site shall be inspected at least weekly for evidence of dust emissions or previously windblown sediments. Dust control measures must be implemented or upgraded if the site inspection shows evidence of wind erosion.

11.4.8 Nets and Mats

Mulch netting, erosion control matting, and turf reinforcement matting (TRM) make up a group of materials that are used to stabilize mulch and soil in order to prevent erosion and aid in the establishment of vegetative cover.

Some mats and TRMs are manufactured by weaving or bonding fibers made from synthetic materials such as polypropylene, polyester, polyethylene, nylon, polyvinyl chloride, glass, and various mixtures of these. These materials are intended to be longer lasting or even permanent in certain applications.

Some nets and mats are formed of biodegradable materials such as jute, coconut, or other wood fibers that have been formed into sheets of mulch that are more stable than loose mulch. Netting is typically made from jute, other wood fiber, plastic, paper, or cotton and can be used to hold the mulching and matting to the ground. Netting can also be used alone to stabilize soils while the plants are growing; however, it does not retain moisture or temperature well.

Design Criteria
Erosion control matting can be used to stabilize channels and swales and on recently planted slopes to protect seedlings until they become established. Refer to Figure 11-1 for guidance on using matting on slopes. See Chapter 8 for additional information on stabilizing vegetated channels.

Effective netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Material Specifications
Nets and mats shall be suitable for their intended purpose. With the wide variety of materials available, the product used should be determined by the designer according to its application.

Construction Specifications
Nets and mats shall be installed according to the manufacturer's recommendations. In the event that the manufacturer's recommendations conflict with any requirement of this manual, the most conservative requirement, in terms of protection of public health and the environment, shall govern. See Figure 11-5 for details on placement of straw or mats. See Figures 11-6 and 11-7 for details regarding placement of TRMs.

11.4.9 Gabion Mattress

Gabion mattresses are acceptable when used as water energy dissipating devices placed at the outlets of pipes or paved channel sections. Gabion mattresses are also known as reno mattresses. The purpose of gabion mattresses is to prevent scour at stormwater outlets and to minimize the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Design Criteria
Gabion mattresses shall be used at the outlets of all pipes, box culverts, stilling basins, and paved ditch sections.

For outlets of 36 inches (width or diameter) or less, the length of the gabion mattress shall be 12 feet. For outlets greater than 36 inches, the gabion mattress length shall be 4 times the width or height of the outlet, whichever is greater. See Figure 11-8.

If the pipe discharges directly into a well-defined channel, the mattress shall extend across the channel bottom and up the channel banks to an elevation 1 foot above the maximum tailwater depth or to the top of the bank (whichever is less). See Figure 11-9. The side slopes of the channel shall not be steeper than 2:1 (Horizontal:Vertical).

If the pipe discharges onto a flat area with no defined channel, the width of the apron shall be in accordance with Figures 11-10 and 11-11.

The mattress shall be constructed with no slope along its length (0.0 percent grade). The invert elevation of the downstream end of the mattress shall be equal to the invert elevation of the receiving channel. There shall be no overfall at the end of the mattress.

Where the outlet structure is supported by a concrete foundation, the first 3 feet of the mattress shall extend the depth of the foundation. See Figure 11-8.

For calculated outlet velocities of 5 to 10 feet per second when flowing full, the depth of the gabion mattress shall be at least 12 inches.

For calculated outlet velocities of greater than 10 feet per second when flowing full, the depth of the gabion mattress shall be at least 18 inches, except when an impact stilling basin is used. In that instance, a minimum depth of 12 inches is required.

When the mattress is placed on grades of 5% or greater, #8 reinforcing bar anchors at 18 inches on centers shall be installed.

Gabion mattresses shall be secured together in accordance with manufacturer's recommendations.

The mattress shall be located so that there are no bends in the horizontal alignment.

For paved channel outlets, the end of the paved channel shall merge smoothly with the gabion mattress in the receiving channel section. There shall be no overfall at the end of the paved section.

Where the bottom width of the paved channel is narrower than the bottom width of the receiving channel, a paved transition section shall be provided.

Material Specifications

The gabion mattress shall be manufactured from galvanized wire with a minimum tensile strength of 40,000 psi.

The stone to be used shall be quarry run crushed limestone 3-6 inches in size.

Filter fabric placed below the gabion mattress shall have the minimum material specifications of the geotextile described in the material specifications for a construction entrance.

Construction Specifications

The subgrade for the mattress shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density approximately that of the surrounding undisturbed material. Brush, trees, stumps, and other objectionable material shall be removed.

Placement of the mattress and the fill rock shall follow immediately after subgrade preparation and be in accordance with methods recommended by the manufacturer.

The anchors shall be 3 feet long and driven or pushed into the subgrade. Where rock is encountered, the anchors shall be cut off even with the mattress.

Filter fabric shall be placed between the mattress and the subgrade.

Maintenance
Outlets shall be inspected at least weekly during the construction process and after every storm of one-half inch or more. If the mattress is damaged or displaced, it shall be repaired immediately.

11.4.10 Temporary Diversion Ditch

A temporary diversion ditch is an earth channel with a supporting ridge or berm on the lower side constructed across the slope. See Figure 11-12 for an illustration. Temporary diversion ditches usually have a life expectancy of one year or less with a low failure hazard. Permanent diversions are called permanent constructed waterways and shall be designed in accordance with requirements in Chapter 8. Diversions can be constructed for various purposes including:

- to divert storm runoff away from unprotected slopes to a stabilized outlet
- to divert sediment-laden runoff from a disturbed area to a sediment pond,
- to shorten the flow length within a long, sloping drainage area

Design Criteria
Temporary diversion ditches must have stable outlets. The combination of conditions of site, slopes, and soils should be so that the ditch can be maintained throughout its planned life.

Temporary diversion ditches shall not be constructed below high sediment-producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with or before the diversion.

Temporary diversion ditches shall be designed for the 10-year, 6-hour storm event in accordance with methods given in the next section for permanent constructed channels.

A typical diversion cross section consists of a channel and a supporting ridge. In the case of an excavated-type diversion, the natural ground serves as the diversion ridge. Diversion cross sections must be adapted to the equipment that will be used for their construction and maintenance.

The channel may be parabolic or trapezoidal in shape. V-shaped ditches shall not be constructed

A diversion's location will be dictated by outlet condition, topography, land use, soil type, and length of slope. Diversions must be located so that water will empty onto an established area such as a stable watercourse, waterway, or structure.

The channel grade for diversions may be uniform or variable. The permissible velocity for the soil type and vegetative cover will determine the maximum grade. The grade should be such as to minimize standing water and wetness problems.

Level diversions with blocked ends may be used when an adequate underground outlet is provided.

Any high sediment-producing area above a diversion should be controlled by good land use management or by structural measures to prevent excessive sediment accumulation in the diversion channel. If movement of sediment into the diversion channel cannot be controlled, one of the following measures should be used:

Design the channel to include extra capacity for the storage of sediment, keep the velocity of flow for the design storm greater than 1.5 feet per second, and provide for clean out of the diversion channel when the sediment storage capacity has been depleted.

Provide a minimum 15-foot wide filter strip of close-growing sod adjacent to the diversion channel and remove excessive accumulations of sediment to maintain a vigorous growth.

Temporary diversions above steep slopes or across graded rights-of-way shall have a berm with a minimum top width of 2 feet, side slopes of 2:1 or flatter and a minimum height of 18 inches measured from the channel bottom.

Diversions installed to intercept flow on graded rights-of-way shall be spaced 200 to 300 feet apart.

A level lip spreader shall be used at diversion outlets discharging onto areas already stabilized by vegetation.

Construction Specifications

All dead furrows, ditches or other depressions to be crossed shall be filled before construction begins or as part of construction, and the earth fill used to fill the depressions will be compacted using the treads of the construction equipment. All old terraces, fencerows, or other obstructions that will interfere with the successful operation of the diversion shall be removed.

The base for the diversion ridge is to be prepared so that a good bond is obtained between the original ground and the fill material. Vegetation is to be removed and the base thoroughly disked prior to placement of fill.

The earth materials used to construct the earth fill portions of the diversions shall be obtained from the diversion channel or other approved source.

The earth fill materials used to construct diversions shall be compacted by running the construction equipment over the fill in such a manner that the entire surface of the fill will be traversed by not less than one tread track of the equipment.

When an excess of earth material results from cutting the channel cross section and grade, it shall be deposited adjacent to the supporting ridge unless otherwise directed.

The completed diversion shall conform to the cross section and grade shown on the design.

Fertilizing, seeding, and mulching shall conform to the recommendations in the applicable vegetative standard and specification.

Maintenance
Bare and vegetated diversion channels shall be inspected regularly to check for points of scour or bank failure; rubbish or channel obstruction; rodent holes, breaching, or settling of the ridge; and excessive wear from pedestrian or construction traffic.

Damaged channels or ridges shall be repaired at the time damage is detected. Sediment deposits shall be removed from diversion channels and adjoining vegetative filter strips regularly.

Diversions shall be reseeded and fertilized as needed to establish vegetative cover.

11.4.11 Level Spreader

Level spreaders are storm flow outlet devices constructed at zero grade across the slope whereby concentrated runoff may be discharged at non-erosive velocities onto undisturbed areas stabilized by existing vegetation. A level spreader is illustrated in Figure 11-13.

Level spreaders dissipate storm flow energy at the outlet by converting storm runoff into sheet flow and discharging it onto areas stabilized by existing vegetation without causing erosion.

Level spreaders are used at diversion outlets and other locations where sediment free storm runoff is intercepted and diverted from graded areas onto undisturbed stabilized areas. The practice applies only in those situations where the spreader can be constructed on undisturbed soil and where the area directly below the level spreader is stabilized by existing vegetation. The water must not be allowed to reconcentrate below the point of discharge.

Design Criteria
The length of the level spreader shall be based on the peak flow from the 100-year storm in accordance with the following table

100-year Peak Flow (cfs)	Minimum Length (ft)
Up to 10	15
11 to 20	20
21 to 30	30
31 to 40	40
41 to 50	50

Construction Specifications
The minimum acceptable width shall be 6 feet. The depth of the level spreader as measured from the lip shall be at least 6 inches and the depth shall be uniform across the entire length of the measure.

The grade of the channel for the last 15 feet entering the level spreader shall be less than or equal to 1%.

The level lip of the spreader shall be constructed on zero percent grade to insure uniform conversion of channel flow to sheet flow.

Level spreaders shall be constructed on undisturbed soil.

The entrance to the spreader shall be graded in a manner to insure that runoff enters directly onto the zero percent graded channel.

Storm runoff converted to sheet flow shall discharge onto undisturbed areas stabilized with vegetation.
All disturbed areas shall be stabilized immediately after construction is completed in accordance with the mulching and vegetation requirements of this manual.

Maintenance
The level spreader shall be inspected after each storm event and at least once each week. Any observed damage shall be repaired immediately.

11.4.12 Pipe Slope Drains

Pipe slope drains are made of flexible pipe and reduce the risk of erosion on slopes by discharging runoff to stabilized areas. See Figures 11-14 and 11-15. They carry concentrated runoff from the top to the bottom of a slope that has already been damaged by erosion or is at high risk for erosion. They are also used to drain saturated slopes that have the potential for soil slides. Pipe slope drains can be either temporary or permanent depending on the method of installation and material used.

Pipe slope drains shall be used whenever it is necessary to convey water down a slope that is steep or otherwise prone to erosion. Pipe slope drains may be used with other devices, including diversion dikes or swales, sediment traps, and level spreaders (used to spread out stormwater runoff uniformly over the surface of the ground).

Design Criteria
Each pipe slope drain shall serve a maximum drainage area of five acres.

The pipe slope drain shall be designed to handle the peak runoff for the 10-year storm.

Material Specifications
The pipe shall be heavy duty flexible tubing designed for this purpose, e.g., nonperforated, corrugated plastic pipe, or specially designed flexible tubing.

A standard flared end section or a standard T-section fitting secured with a watertight fitting shall be used for the inlet.

Extension collars shall be 12-inch long sections of corrugated pipe. All fittings shall be watertight.

Construction Specifications
The pipe slope drain shall be placed on undisturbed or well-compacted soil.

Soil around and under the entrance section shall be hand-tamped in 4-inch to 8-inch lifts to the top of the dike to prevent piping failure around the inlet.

Filter cloth shall be placed under the inlet and extended 5 feet in front of the inlet and be keyed in 6 inches on all sides to prevent erosion.

Backfilling around and under the pipe with stable soil material hand compacted in lifts of 4 inches to 8 inches shall be done to ensure firm contact between the pipe and the soil at all points.

The pipe slope drain shall be securely staked to the slope using grommets provided for this purpose at intervals of 10 feet or less.

All slope drain sections shall be securely fastened together and have watertight fittings.

The pipe shall be extended beyond the toe of the slope and discharged at a non-erosive velocity into a stabilized area (e.g., gabion mattress) or to a sediment trap or pond.

The pipe slope drain shall have a minimum slope of 3 percent or steeper.

The height at the centerline of the earth dike shall range from a minimum of 1.0 foot over the pipe to twice the diameter of the pipe measured from the invert of the pipe. It shall also be at least 6 inches higher than the adjoining ridge on either side. At no point along the dike will the elevation of the top of the dike be less than 6 inches higher than the top of the pipe.

All areas disturbed by installation or removal of the pipe slope drain shall be immediately stabilized.

Maintenance
The pipe slope drain shall be inspected after every rainfall and at least weekly. Any necessary repairs shall be made immediately.

Check to see that water is not bypassing the inlet and undercutting the inlet or pipe. If necessary, install headwall or sandbags.

Check for erosion at the outlet point and check the pipe for breaks or clogs. Install additional outlet protection if needed and immediately repair the breaks and clean any clogs.

Do not allow construction traffic to cross the pipe slope drain and do not place any material on it.

If a sediment trap has been provided, it shall be cleaned out when the sediment level reaches 1/3 to 1/2 the design volume.

The pipe slope drain shall remain in place until the slope has been completely stabilized or up to 30 days after permanent slope stabilization.

11.4.13 Impact Stilling Basin

Impact stilling basins are concrete structures placed at the outlets of culverts and storm sewer pipes with calculated exit velocities greater than 15 feet per second. The purpose of an impact stilling basin is to dissipate energy at a high velocity outlet to protect the receiving channel.

Design Criteria
Impact stilling basins shall be designed in accordance with LFUCG Division of Engineering Standard Drawings.

Construction Specifications
Construction specifications for impact stilling basins are provided in the Standard Drawings

11.5 Structural Sediment Control BMPs

11.5.1 Check Dam

A check dam is a small temporary dam constructed across a swale or drainage ditch. The purpose of a check dam is to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. This practice also traps small amounts of sediment generated in the ditch itself. However, this is not a sediment-trapping practice and should not be used as such.

Design Criteria
Check dams shall be limited to use in small, open channels that drain 10 acres or less.

Check dams shall not be used in streams.

Check dams are especially applicable where the gradient of waterways is close to the maximum for a grass lining.

Check dams can be constructed of stones, coir logs, or wood fiber logs. See Figures 11-16 and 11-17.

The maximum height of a check dam shall be three feet above the ground on which the rock is placed.

The center of the portion of the check dam above the flat portion of the channel shall be at least 1 foot lower than the outer edges. The outer edges of the check dam shall extend up the side slopes of the channel to a point 3 feet in elevation above the center portion of the check dam or to the top of the side slopes.

The maximum spacing between rock check dams in a ditch should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

The spacing of coir and wood fiber check dams is one log every 100 feet for velocities of 5 fps, 50 feet for velocities between 5 and 7.5 fps, and 25 feet for velocities greater than 10 fps.

Material Specifications
Stone check dams shall be constructed of KYTC Class II channel lining.

Coir log or wood fiber log check dams shall be constructed of a single log with a diameter of at least 20 inches.

Construction Specifications
Stone shall be placed by hand or mechanically as necessary to achieve complete coverage of the ditch and to ensure that the center of the dam is at least 1 foot lower than the outer edges. Stone shall also be placed to extend 3 feet in elevation above the center portion of the check dam or to the top of the channel side slopes.

Coir and wood fiber logs shall be laid on the channel bottom.

Check dams must be removed when their useful life has been completed. In temporary ditches and swales, check dams shall be removed and the ditch filled in when it is no longer needed. In permanent channels, check dams shall be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams shall be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams shall be seeded and mulched or sodded (depending upon velocity) immediately after check dams are removed.

If stone check dams are used in grass-lined channels that will be mowed, care shall be taken to remove all stone from the channel when the dam is removed. This shall include any stone that has washed downstream.

Maintenance

Regular inspections shall be made to ensure that the measure is in good working order and the center of the dam is lower than the edges. Erosion caused by high flows around the edges of the dam shall be corrected immediately, and the dam shall be extended beyond the repaired area.

Check dams shall be checked for sediment accumulation after each rainfall. Sediment shall be removed when it reaches one-half of the original height or before.

Check dams shall remain in place and operational until the drainage area and channel are completely stabilized or up to 30 days after the permanent site stabilization is achieved.

11.5.2 Sediment Trap

A sediment trap is formed by an excavation of an area in a suitable location to retain sediment and other waterborne debris. Sediment traps are considered temporary structures.

This standard establishes minimum acceptable criteria for the design and construction of sediment traps formed by excavation. This standard is limited to sites where the drainage area is less than 5 acres.

Sediment traps shall be used where physical site conditions or other restrictions prevent other erosion control measures from adequately controlling erosion and sedimentation. Sediment traps may be used down slope from construction operations that expose areas to erosion. Sediment traps shall be removed after the exposed areas are adequately protected against erosion by vegetative or mechanical means.

General Design Criteria

Erosion control practices such as seeding, mulching, sodding, diversion dikes, etc., shall be used in conjunction with sediment traps to reduce the amount of sediment flowing into the trap.

The amount of sediment entering a trap can be reduced by the use of stabilized diversion dikes and ditches. The trap shall not be located in a stream. It shall be located to trap sediment-laden runoff before it enters the stream.

The minimum capacity of the sediment trap to the elevation of the crest of the spillway shall be 3,600 cubic feet for each acre within the drainage area that will be disturbed by construction during the design life of the trap.

The trap dimensions necessary to determine the designed sediment volume shall be clearly shown on the plans to facilitate plan review, construction, operation, and maintenance. Trap depth shall be at least 2 feet at the inlet and 4 feet at the outlet. Effective trap width shall be at least 10 feet and trap length shall be at least 30 feet. See Figure 11-18.

The erosion and sediment control plan shall indicate the final disposition of the sediment trap after the upstream drainage area is stabilized. The plans shall indicate methods for the removal of excess water lying over the sediment, stabilization of the pond site, and the disposal of any excess material.

Construction Specifications

The area to be excavated shall be cleared of all trees, stumps, roots, brush boulders, sod, and debris. All channel banks and sharp breaks shall be sloped to no steeper than 1:1. All topsoil containing excessive amounts of organic matter shall be removed.

Seeding, fertilizing, and mulching of the material taken from the excavation shall comply with the applicable soil stabilization sections of this manual.

Any material excavated from the trap shall be placed in one of the following ways so that it will not be washed back into the pond by rainfall:

- uniformly spread to a depth not exceeding 3 feet and graded to a continuous slope away from the trap
- uniformly placed or shaped reasonably well with side slopes assuming the natural angle of repose for the excavated material behind a berm width not less than 12 feet

Maintenance

Sediment shall be removed from the trap when the capacity is reduced to 50 percent of the design volume. Plans for the sediment trap shall indicate the methods for disposing of sediment removed from the pond.

11.5.3 Sediment Pond

A sediment pond is formed by a barrier or dam constructed across a drainage way or other suitable location to retain sediment and other waterborne debris. Sediment ponds are considered temporary structures. They can be converted to permanent detention ponds or

storage structures for runoff control, if they are designed and constructed in accordance with applicable requirements of storage structures given in Chapter 10.

This standard establishes minimum acceptable criteria for the design and construction of sediment ponds formed by an embankment, excavation, or a combination of embankment and excavation. This standard is limited to sites where:

- failure of the structure would not result in loss of life; damage to homes; damage to commercial or industrial buildings; damage to highways or railroads; or interruption of public or private utility service (hazard class "A" only)
- the height of the dam is 20 feet or less, as measured from the natural streambed at the downstream toe of the dam to the top of the dam
- the drainage area is more than 5 acres but less than 100 acres
- the pond will be removed within a three-year period after construction

Sediment ponds are appropriate where physical site conditions or other restrictions prevent other erosion control measures from adequately controlling erosion and sedimentation. Sediment ponds may be used down slope from construction operations that expose areas to erosion. Sediment ponds shall be removed after the exposed areas are adequately protected against erosion by vegetative or mechanical means.

General Design Criteria

Sediment ponds shall be designed to meet one of the following design criteria:

- remove 80% of the total suspended solids for the 10 year storm; a computer program such as SEDCAD may be used
- a detention time of 24-48 hours for the 10 year storm

Design and construction shall comply with all federal, state, and local laws, ordinances, rules, and regulations regarding dams.

Erosion control practices such as seeding, mulching, sodding, diversion dikes, etc., shall be used in conjunction with sediment ponds to reduce the amount of sediment flowing into the pond.

The amount of sediment entering a pond can be reduced by the use of stabilized diversion dikes and ditches. The pond shall not be located in a stream. It shall be located to trap sediment-laden runoff before it enters the stream.

A sand filter outlet may be used in the bottom of the pond. See Figure 11-19. A perforated riser may also be used.

Permanent ponds designed for stormwater detention or water quality treatment may serve as temporary sediment ponds if site conditions make the use of these structures desirable. At the time of conversion from a sediment pond to a permanent stormwater management pond, excess sediment shall be cleaned from the pond. If the pond is converted to a water quality

basin, the sand in the sand filter outlet shall be replaced with clean sand unless it is shown to be clean.

The minimum capacity of the sediment pond to the elevation of the crest of the pipe spillway shall be 3,600 cubic feet for each acre within the drainage area that will be disturbed by construction during the design life of the sediment pond.

Detention storage shall be provided above the sediment storage volume to reduce peak discharges for the 10-year and 100-year storms during construction to pre-development levels.

Pond dimensions necessary to determine the designed sediment volume shall be clearly shown on the plans to facilitate plan review, construction, operation, and maintenance.

The pond configuration shall be such that the effective flow length through the pond is at least two times the average width of the pond. Baffles will be used when necessary to prevent short-circuiting by increasing the effective flow length.

The minimum freeboard for the maximum applicable design storm shall be 1.0 foot.

For embankments of 5 feet or less, the minimum top width shall be 5 feet. For embankments of over 5 feet, the minimum top width shall be 10 feet.

Embankment side slopes shall be no steeper than 3H:1V.

Sediment pond plans shall indicate the final disposition of the sediment pond after the upstream drainage area is stabilized. The plans shall indicate methods for the removal of excess water lying over the sediment, stabilization of the pond site, and the disposal of any excess material.

Vegetation shall be established upon completion of construction of the embankment, emergency spillway and other areas disturbed by construction.

Sand Filter Outlet Design Criteria

Figure 11-19 illustrates an outlet that may be used to regulate discharge from the sediment pond. To size this device, pick a preliminary configuration and check it using the falling head permeability equation. Set t equal to 24 hours and calculate k. The calculated k should not be greater than 0.146 ft/hr. If necessary, adjust the filter dimensions and recalculate.

The falling head equation is:

$k = 2.303 * (aL/At) * \log (H/h)$
where:
k = coefficient of permeability (ft/hr),
a = average surface area of sediment pond at the elevation of the principal spillway (ft^2),
L = depth of sand (ft),

A = surface area of filter = width of sand layer * length of sand layer (ft^2),
t = time (hr),
H = height of water over the perforated pipe with top of pool at principal spillway (ft), and
h = height of filter from the top of the perforated pipe to the top of the sand (ft).

Pipe Spillway Design Criteria

The capacity of a pipe spillway shall be sufficient to pass the runoff of a 10-year storm with a detention time of 24-48 hours. The minimum diameter of the conduit shall be 8 inches.

The crest elevation of the principal spillway shall be at the elevation of the designed sediment volume. See Figure 11-20.

The trickle tube shall discharge at approximately the lowest elevation of the valley cross section at the downstream toe of the dam. Protection using gabion mattresses, concrete aprons, or other acceptable materials will be used to convey pipe discharge to a stable channel or a level spreader in an erosion free manner.

Anti-seep collars shall be installed around the pipe barrel for all installations where the height of earth fill over the top of pipe is 5 feet or greater. The combination of the number of collars and the collar projections must increase the length of the line of seepage by at least 15 percent. Where more than one collar is used, they shall be spaced approximately 25 feet apart.

Emergency Spillway Design Criteria

For embankments of 5 feet or less in height, the embankment shall be used as an emergency spillway and the downstream slope shall be 5H:1V or flatter. In addition, the downstream slope of the embankment shall be immediately protected with rock riprap.

Emergency spillways shall be constructed for all sediment ponds having an embankment height greater than 5 feet. The spillway cross section shall be trapezoidal with a minimum bottom width of 8 feet and side slopes of 2H:1V or flatter.

For embankments greater than 5 feet in height, the emergency spillway channel shall be located so that it will not be constructed over fill material. The channel shall be located so there are no sharp turns or bends. The channel shall return the flow of water to a defined channel downstream from the embankment.

The crest of the emergency spillway shall be set at the elevation required to pass the 10-year storm through the pipe spillway. In no case shall the difference in elevation between the crests of the pipe spillway and the emergency spillway be less than 1.0 foot.

The minimum capacity of the emergency spillway shall be that required to pass the peak-rate of runoff from the 100-year storm with one foot of freeboard, assuming the pipe spillway is blocked.

The maximum allowable velocity of flow in the exit section of vegetated emergency spillways shall be 6 feet per second. For spillways with erosion protection other than vegetation, velocities or critical shear forces shall be in the safe range for the type of protection used.

The emergency spillway shall have a control section at least 20 feet in length. The control section is a level portion of the spillway channel at the highest elevation in the channel.

Construction Specifications

The foundation area shall be cleared of all trees, stumps, roots, brush boulders, sod, and debris. All channel banks and sharp breaks shall be sloped to no steeper than 1:1. All topsoil containing excessive amounts of organic matter shall be removed. The surface of the foundation area shall be thoroughly scarified before placement of the embankment material.

A cutoff trench shall be backfilled with suitable material. The trench shall be kept free of standing water during backfill operations.

The pipe conduit barrel shall be placed on a firm foundation. Selected backfill material shall be placed around the conduit in layers, and each layer shall be compacted to at least the same density as the adjacent embankment. All compaction within 2 feet of the pipe spillway shall be accomplished with hand-operated tamping equipment.

All borrow areas outside the pond and in the drainage area shall be graded and left in such a manner that water will not be ponded.

The material placed in the fill shall be free of all sod, roots, frozen soil, stones more than 6 inches in diameter, and other objectionable material. The placing and spreading of the fill material shall occur in approximately 6-inch horizontal layers or of such thickness that the required compaction can be obtained with the equipment used. Each layer shall be compacted in a way that will result in achieving 95 percent of the maximum standard dry density.

The distribution and gradation of materials throughout the fill shall be such that there will be no lenses, pockets, stakes, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the fill.

The moisture content of fill material shall be such that the required degree of compaction can be obtained with the equipment used.

Fill shall not be placed on frozen, slick, or saturated soil.

The topsoil material saved in the site preparation shall be placed as a top dressing on the surface of the emergency spillways, embankments, and borrow areas. It shall be evenly spread.

A protective cover of herbaceous vegetation shall be established on all exposed surfaces of the embankment, spillway, and borrow areas to the extent practical under prevailing soil and climatic conditions.

Seedbed preparation, seeding, fertilizing, and mulching shall comply with the applicable sections of this manual.

Any material excavated from the pond shall be placed in one of the following ways so that its weight will not endanger the stability of the side slopes and where it will not be washed back into the pond by rainfall:

- uniformly spread to a depth not exceeding 3 feet and graded to a continuous slope away from the pond
- uniformly placed or shaped reasonably well with side slopes assuming the natural angle of repose for the excavated material behind a berm width not less than 12 feet

Maintenance
Sediment shall be removed from the pond when the capacity is reduced to 50 percent of the design volume. Plans for the sediment pond shall indicate the methods for disposing of sediment removed from the pond.

11.5.4 Silt Fence

Silt fence is a temporary barrier to trap sediment that consists of a filter fabric stretched between supporting posts, with the bottom entrenched in the soil and with a wire support fence. The purpose of a silt fence is to intercept and detain water allowing the settling of small amounts of sediment from disturbed areas during construction operations to prevent sediment from leaving the site and entering streams or sinkholes.

Design Criteria
Silt fences are appropriate where the size of the drainage area is no more than one-fourth acre per 100 feet of silt fence length; the maximum slope length behind the barrier is 100 feet; and the maximum gradient behind the barrier is 50 percent (2H:1V). Silt fences can be used at the toe of stockpiles where the slope exceeds 2H:1V, but in that case, the slope length should not exceed 20 feet.

Silt fences can be used in minor swales or ditch lines where the maximum contributing drainage area is no greater than 2 acres

Under no circumstances shall silt fences be constructed in streams or in swales or ditch lines where flows are likely to exceed 1 cubic foot per second (cfs).

Silt fences composed of synthetic fabric have an expected usable life of 6 months.

Material Specifications

Synthetic filter fabric shall be a pervious sheet of propylene, nylon, and polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the following requirements:

PHYSICAL PROPERTY	**REQUIREMENTS**
Filtering Efficiency	75% (minimum)
Tensile Strength at 20%	50 lbs./linear inch (minimum)
Flow Rate	0.3 gal./ sq. ft/ min. (minimum)

Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0°F to 120°F.

Posts for synthetic fabric silt fences shall be either 2-inch by 2-inch wood or 1.33 pounds per linear foot steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them.

Wire fence reinforcement for silt fences shall be a minimum of 36 inches in height, a minimum of 14 gauge and shall have a mesh spacing of no greater than 6 inches.

Construction Specifications

This section provides construction specifications for silt fences using synthetic fabric. See Figure 11-21 for an illustration and Figure 11-22 for general notes.

Posts shall be spaced a maximum of 10 feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When necessary because of rapid runoff, post spacing shall not exceed 6 feet.

A trench shall be excavated at least 6 inches wide and 6 inches deep along the line of posts and upslope from the barrier.

A wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy-duty wire staples at least 1 inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of 2 inches and shall not extend more than 36 inches above the original ground surface.

The filter fabric shall be stapled or wired to the fence, and 12 inches of the fabric shall be extended into the trench. The fabric shall not extend more than 30 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

At joints, filter fabric should be lapped with terminating posts with a minimum overlap of 3 feet.

The trench shall be backfilled and soil compacted over the filter fabric.

Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

Maintenance
Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately. Knocked down fences shall be repaired at the end of each day.

Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.

Sediment deposits shall be removed after each storm event or when deposits reach approximately one-half the height of the barrier.

Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared, and seeded.
Silt fences shall be replaced every 6 months.

11.5.5 Storm Drain Inlet Protection

A sediment filter installed around a storm drain drop inlet or curb inlet is referred to as storm drain inlet protection. Its purpose is to prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area. This practice should be used when storm drain inlets are to be operational before permanent stabilization of disturbed areas in the watershed. Curb inlet protection is not required if other soil stabilization and sediment control measures are in place to prevent sediment from entering the street.

Design Criteria
The drainage area shall be no greater than 1 acre.

The inlet protection device shall be constructed in a manner that will facilitate cleanout and disposal of trapped sediment and minimize interference with construction activities.

Inlet protection devices shall be constructed in such a manner that any resultant ponding of stormwater will not cause excessive inconvenience or damage to adjacent areas or structures.

Specifications-Drop Inlet Filters
For silt fence inlet protection (illustrated in Figure 11-23), the following specifications apply:

- For stakes, use 2 x 4-inch wood (preferred) or equivalent metal with a minimum length of 3 feet.

- Space stakes evenly around the perimeter of the inlet a maximum of 3 feet apart, and securely drive them into the ground, approximately 18 inches deep.

- To provide needed stability to the installation, frame with 2 x 4-inch wood strips around the crest of the overflow area at a maximum of 1.5 feet above the drop inlet crest and brace diagonally.

- Place the bottom 12 inches of the fabric in a trench and backfill the trench with at least 4 inches of crushed stone or 12 inches of compacted soil.

- Fasten fabric securely to the stakes and frame. Joints must be overlapped to the next stake.

For sod drop inlet protection, sod shall be placed to form a turf mat covering the soil for a distance of 4 feet from each side of the inlet structure. Soil preparation and sod placement shall be in accordance with the section entitled Sodding.

Specifications-Curb Inlet Filters

For gravel curb inlet protection (shown in Figure 11-24), the following specifications apply:

- Wire mesh with ½-inch openings shall be placed over the curb inlet opening so that at least 12 inches of wire extends across the concrete gutter from the inlet opening.

- KYTC No. 2 Coarse Aggregate shall be piled against the wire so as to anchor it against the gutter and inlet cover and to cover the inlet opening completely.

- A gravel filtering device has no overflow mechanism, therefore, ponding is likely. This type of device must never be used where overflow may endanger an exposed fill slope. Consideration should also be given to the possible effects of ponding on traffic movement, nearby structures, working areas, and adjacent property.

- For block and gravel curb inlet protection (illustrated in Figure 11-25), the following specifications apply:

- Two concrete blocks shall be placed on their sides abutting the curb at either side of the inlet opening to act as spacer blocks.

- A 2-inch by 4-inch stud shall be cut and placed through the outer holes of each spacer block to help keep the front blocks in place.

- Concrete blocks shall be placed on their sides across the front of the inlet and abutting the spacer blocks.

- Wire mesh shall be placed over the outside of the concrete blocks to prevent stone from being washed through the holes in the blocks. Wire with ½-inch openings shall be used.

- KYTC No. 2 Coarse Aggregate shall be piled against the wire to the top of the barrier.

Maintenance
The structure shall be inspected after each rain, and repairs made as needed.

Sediment shall be removed and the device restored to its original dimensions when the sediment has accumulated to one-half the design depth of the filter. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

If a stone filter becomes clogged with sediment so that it no longer adequately performs its function, the stone must be pulled away from the blocks, cleaned, and replaced.
Structures shall be removed after the drainage area has been properly stabilized.

11.5.6 Filter Strips

A filter strip is a strip of vegetation for removing sediment and related pollutants from runoff. Filter strips are also called vegetative filters. This practice uses infiltration, deposition, absorption, and decomposition to reduce pollution in runoff. Filter strips are applicable to land undergoing development where this practice can reduce sediment damage to adjacent property, streams, wetlands, or sinkholes.

Design Criteria
Filter strips shall only be used to remove sediment from overland flow. Filter strips are not effective in removing sediment from concentrated flows.

Vegetative filters cannot be expected to remove all sediment or adequately protect adjacent areas from sediment damage when used alone. Vegetative filters should only be considered as one component of the erosion and sediment control system.

If vegetative filters are proposed as a sediment control device and they do not already exist, they shall be planned and established prior to initiating land disturbing activities.

Minimum filter strip width shall be 50 feet for streams, wetlands, and sinkholes. The minimum filter strip width shall be ten feet for constructed waterways. See Figure 11-26.

Where a post development floodplain or wet weather conveyance is being protected, filter strips shall be provided on each side. When a wetland or sinkhole is being protected, filter strips shall be provided around the perimeter.

Plans shall show the location, width, and length of filter strips. The type of vegetation and specifications for soil preparation and seeding shall be included. If existing vegetation is to be used, plans for protecting or improving it shall be provided.

Material Specifications

Existing grass or grass/legume mixtures used as filter strips shall be dense and well established, with no bare spots. When establishing new seeding, consideration shall be given to wildlife needs and soil conditions on the site. The following chart provides a list of alternative grass and grass/legume mixtures:

SEEDING MIXTURE AND SITE SUITABILITY CHART

Seeding Mixture	Rate Lbs./Acre	Soil Suitability
1. Alfalfa	10	Well Drained
or Red Clover	10	
Plus		
Timothy	4	
or Orchardgrass	6	
or Bromegrass	6	
2. Landino Clover	½	Wet or Well Drained
Plus		
Timothy	4	
or Orchardgrass	6	
or Bromegrass	8	

Notes:

1.) All seeding shall be in accordance with the seeding sections of this manual

2.) Well drained sites include sites that are drained with tile as well as naturally well drained and droughty sites. Wet sites include sites that are excessively wet only a portion of the growing season.

Construction Specifications

When planting filter strips, prepare seedbed, incorporate fertilizer, and apply mulch consistent with the seeding sections of this manual. Filter strips using areas of existing vegetation shall be over seeded, as necessary, with the above mixtures to obtain an equivalent density of vegetation. The over seeding shall be accomplished prior to the land disturbing activity.

Maintenance

Filter strips shall be inspected regularly to ensure that a healthy vegetative growth is maintained. Any bare spots or spots where sediment deposition could lead to the destruction of vegetation shall be repaired.

Filter strips shall be fertilized once each year in the fall. Irrigation shall be used as necessary to maintain the growth of the vegetation in the filter strip.

Sediment shall be removed when it becomes visible in the filter.

Construction traffic shall not be permitted to drive upon filter strips.

11.5.7 Temporary Stream Crossing

A temporary stream crossing is a temporary structural span installed across a flowing water course for use by construction traffic. Structures may include bridges, round pipes, or pipe arches. The purpose of a temporary stream crossing is to provide a means for construction traffic to cross flowing streams without damaging the channel or banks and to keep sediment generated by construction traffic out of the stream.

Design Criteria

Temporary stream crossings are applicable to flowing streams with drainage areas less than one square mile. Structures that must handle flow from larger drainage areas shall be designed as permanent structures by a professional engineer.

Temporary stream crossings shall be planned to be in service for the shortest practical period of time and to be removed as soon as their function is completed.

Such structures are subject to the rules and regulations of the U.S. Army Corps of Engineers for in-stream modifications (404 permits) and the Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water (401 certification).

The span shall be designed to withstand the expected loads from heavy construction equipment that will cross the structure.

The structure shall be large enough to convey the peak flow expected from a 2-year storm without appreciably altering the stream flow characteristics. The structure may be a span, a culvert, or multiple culverts.

The minimum-sized culvert shall be 18 inches.

Where culverts are installed, compacted soil or rock shall be used to form the crossing. The depth of soil or rock cover over the culvert shall be equal to one-half the diameter of the culvert or 12 inches, whichever is greater. The sides of the fill shall be protected from erosion using the mulching and seeding erosion control measures specified in this manual.

The slope of the culvert shall be at least 0.25 inches per foot.

Material Specifications

When using a culvert crossing, the top of a compacted earth fill shall be covered with six inches of KTC No. 57 stone.

No. 57 stone shall also be used for the stone pads forming the crossing approaches.

Construction Specifications
Clearing and excavation of the streambed and banks shall be kept to a minimum.

The structure shall be removed as soon as it is no longer necessary for project construction.

Upon removal of the structure, the stream shall immediately be reshaped to its original cross section and properly stabilized.

The approaches to the structure shall consist of stone pads with a minimum thickness of 6 inches, a minimum width equal to the width of the structure, and a minimum approach length of 25 feet on each side.

Maintenance
The structure shall be inspected after every rainfall and at least once a week and all damages repaired immediately.

11.5.8 Pump-Around Flow Diversion

Pump-around flow diversions must be used to divert flow during excavation operations in streams. Pump-around flow diversions provide dry working conditions during construction in streams. Diverting stream flow around the work area prevents suspension of sediment in stream flow by construction activities. See Figure 11-27 for an illustration of a pump-around flow diversion.

Design Criteria
Size the diversion pump based on normal stream flow. Dewatering pump should be sized based on the size of the work area, the time allowed for dewatering, and the expected rate of groundwater flow into the excavation.

The check dams to form the diversion shall span the banks of the stream. Maintain 1-foot freeboard (minimum) on the upstream and downstream checks.

Check dams may be constructed of sandbags or may be a water-filled bladder such as an Aqua-Barrier.

The dewatering flow from the work area must be treated in a sediment-trapping device prior to discharge to the stream.

Material Specifications
Sandbags shall be woven polypropylene bags with approximate dimensions of 18-1/2 inches by 28 inches. Tie the ends of filled bags closed using either draw strings or wire ties.

Construction Procedures and Specifications
Schedule operations such that diversion installation, in-stream excavation, in-stream construction, stream restoration, and diversion removal are completed as quickly as possible. Do not construct in a stream when rainfall is expected during the time excavation will be occurring in the stream.

Install check dams across the stream during low flow conditions.

Pump stream flow around the check dams. Install outlet protection as required at the discharge.

Dewater the work area and pump into a sediment trapping device.

Complete construction activities across the stream.

Restore the streambed and banks.

Remove sandbags and shut down pumping operation. (Salvage sandbags for future use if multiple stream crossings are required on the project.) Remove all sandbags from the stream, including damaged and empty bags.

Pumps shall be manned around-the-clock when the pump-around diversion is in the stream.

Maintenance
This control provides short-term diversion of stream flow (typically 1 day to 3 days). Additional sandbags or pumps may be required to maintain 1-foot freeboard on the sandbag checks if flow conditions change.

Add sandbags as required to seal leaks in checks.

11.5.9 Construction Dewatering

Dewatering is the pumping of stormwater or groundwater from excavation pits or trenches. The sediment-laden water must be pumped to a dewatering structure before it is discharged offsite. The purpose of a dewatering structure is to remove sediment from the water before it is discharged.

Design Criteria
There are several types of dewatering structures that may be used. A well-stabilized vegetated area may serve as a filtering structure if it can withstand the velocity of the discharged water. The minimum filter length must be at least 75 feet.

Other methods that may be used include a sediment trap/basin, portable sediment tank, a straw bale/silt fence pit, or a commercial sediment filter bag. The structure must be sized to allow pumped water to flow through the structure without overtopping.

Construction Specifications
See the specifications in this manual for sediment traps and basins. The manufacturer's recommendations should be followed for commercial products.

Maintenance
The dewatering structure should be inspected frequently to ensure it is functioning properly and not overtopping. Accumulated sediment should be spread out on site and stabilized, or disposed of offsite.

11.5.10 Concrete Washout Pits

Concrete washout pits shall be constructed to minimize the discharge of pollutants into streams and storm sewers. A minimum of one washout pit per 40 lots shall be constructed.

Design Criteria
The washout pits shall be sized approximately 20'x20'x5'. Alternative designs shall be submitted to the Division of Engineering for review and acceptance.

Construction Specifications
The pits shall be lined with a 10 mil plastic linter and located outside of the road right-of-way. A #2 stone rock entrance to the pit shall also be constructed. Manufactured signage directing the drivers to the pits shall be installed and maintained by the Developer.

Maintenance
The pits shall be maintained in good working order by the Developer throughout the home-building phase of the project. The pits shall be cleaned when they reach approximately 75% of their volume.

11.6 Erosion Control Requirements for Home Builders

The home builder shall install the erosion and sediment controls described below to minimize the sediment washing into streets, inlets, stormwater pipes, open channels, and adjacent lots. Builders who own multiple adjoining lots may treat them as a single project.

Enforcement
Home builders who fail to install the erosion and sediment controls will be issued a notice of violation. Failure to correct the problem may lead to additional enforcement action.

Silt Fence
A silt fence shall be properly installed prior to clearing and grading the lot. The silt fence is not required around the entire perimeter of the lot but must be installed down-slope of all disturbed areas.

The silt fence shall be firmly entrenched and attached to wood or steel posts spaced 6 feet apart. The trench is typically 6”x6”. The posts go on the downhill side of the fence. The posts are typically 2”x2”x36” wood and shall be driven firmly into the ground. The silt fence fabric should be at least 18” in height above the ground.

Construction Entrance
A construction entrance of No. 2 stone, 6” thick, shall be installed where the driveway will be constructed. The stone should not be placed in the gutter. If a box curb is present, it should be cut and removed.

Seed, Sod, and Mulch
The lot shall be seeded and mulched, or sodded, within 14 days after final grading. Areas that have not reached final grade, but will remain inactive for more than 21 days, shall be seeded and mulched. Sod shall be used for channels that require immediate vegetative cover. Mulch without seed may be applied during December, January, and February, but seeding shall occur as soon as possible in the spring.

Disposal of Trash
Each day, all scrap building materials and litter that could be carried away by wind or water must be hauled off-site or placed in an on-site dumpster. This includes food packages, cans, bottles, paper, and scrap building materials such as wood, drywall, shingles, etc.

Curb Inlet Protection
Rock bags or other devices shall be used to keep sediment from washing into curb inlets. Do not completely block the curb opening because that could lead to flooding during heavy rain.

Surface Inlet Protection
A silt fence or other device shall be used to keep sediment from washing into surface inlets.

Inspection of Sediment Controls
The home builder shall inspect the sediment controls each working day and repair them as necessary. In addition, sediment shall be removed from behind silt fences and other sediment controls to keep them functioning properly.

Street Cleaning
The home builder shall clean sediment off the street to prevent it from becoming muddy and slick.

Alteration of Drainage System
The home builder shall not regrade the lot to move a swale, channel, or stream. The home builder shall not fill in a floodplain, detention/retention pond, swale, channel, or stream.

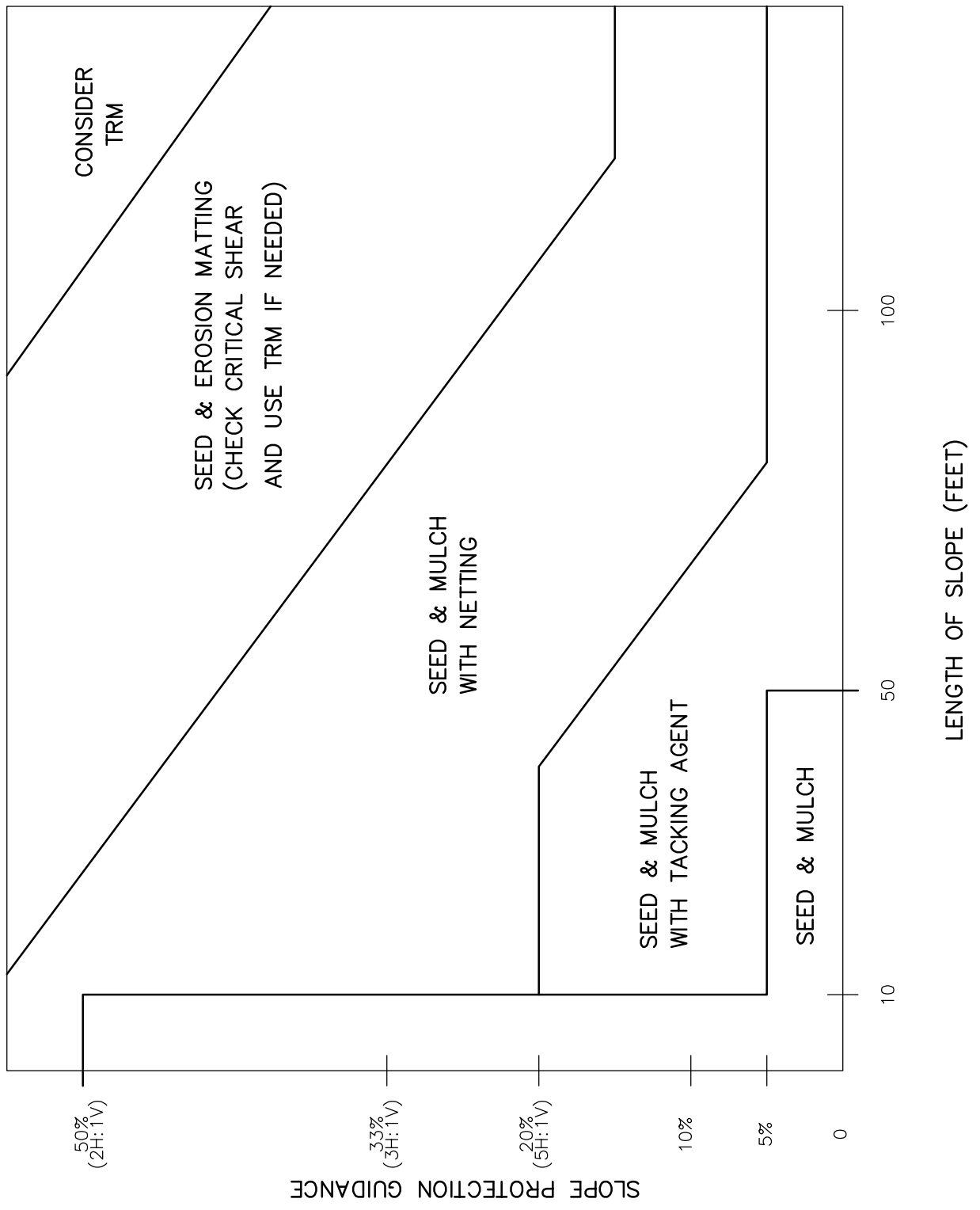
Snow Fence
Snow fence shall be used to keep vehicles off the lot along the street frontage if silt fence is not necessary for sediment control at that location.

STORMWATER MANUAL

FIGURE 11–1

SLOPE PROTECTION GUIDANCE

(EFFECTIVE DATE 1/01/09)

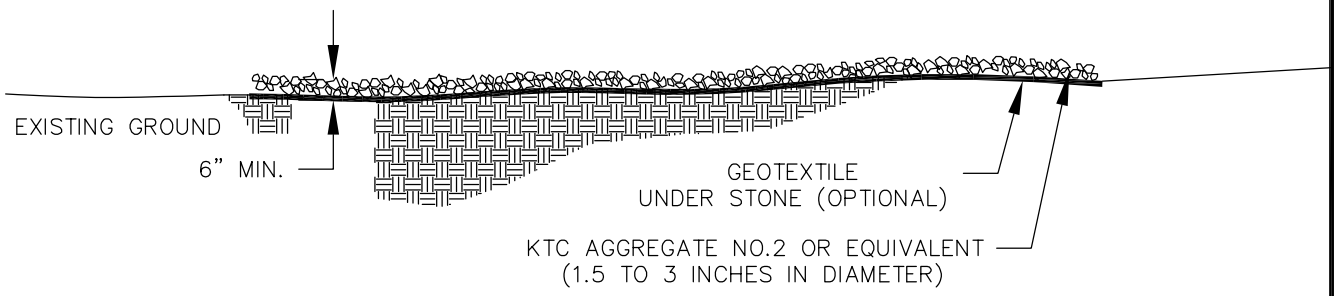


STORMWATER MANUAL

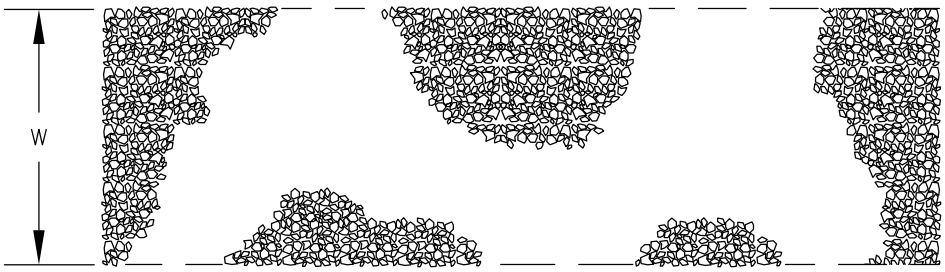
FIGURE 11-2

ROAD\PARKING STABILIZATION

(EFFECTIVE DATE 1/01/09)



CROSS SECTION



PLAN VIEW

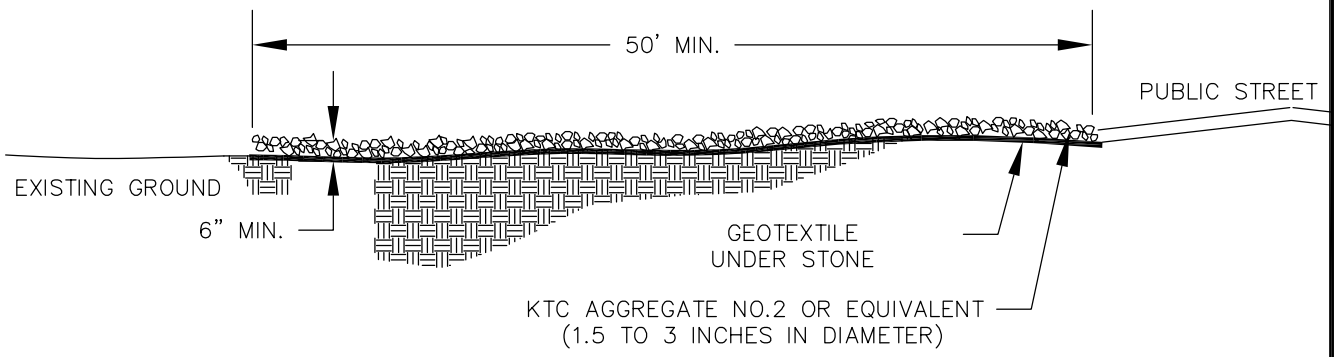
W = 14' MIN. FOR ONE WAY TRAFFIC
20' MIN. FOR TWO WAY TRAFFIC

STORMWATER MANUAL

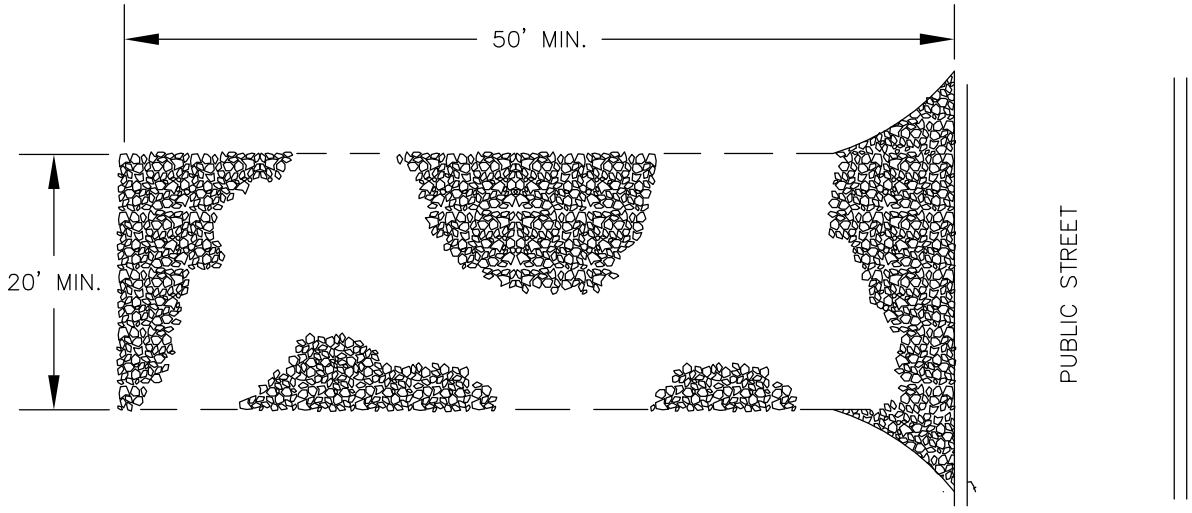
FIGURE 11-3

CONSTRUCTION ENTRANCE

(EFFECTIVE DATE 1/01/09)



CROSS SECTION



PLAN VIEW

STORMWATER MANUAL

FIGURE 11–4

CONSTRUCTION ENTRANCE
NOTES AND SPECIFICATIONS

(EFFECTIVE DATE 1/01/09)

SPECIFICATIONS FOR GEOTEXTILE FABRIC

GRAB TENSILE STRENGTH	220 LBS. (MIN.) (ASTM D1682)
ELONGATION FAILURE	60% (MIN.) (ASTM D1682)
MULLEN BURST STRENGTH	430 LBS. (MIN.) (ASTM D3768)
PUNCTURE STRENGTH	125 LBS. (MIN.) (ASTM D751) (MODIFIED)
EQUIVALENT OPENING	SIZE 40–80 (US STD SIEVE) (CW–02215)

NOTES

1. A STABILIZED ENTRANCE PAD OF CRUSHED STONE SHALL BE LOCATED WHERE TRAFFIC WILL ENTER OR LEAVE THE CONSTRUCTION SITE ONTO A PUBLIC STREET.
2. SOIL STABILIZATION FABRIC SHALL BE USED AS A BASE FOR THE CONSTRUCTION ENTRANCE.
3. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC STREETS OR EXISTING PAVEMENT. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS WARRANT AND REPAIR OR CLEAN OUT OF ANY MEASURES USED TO TRAP SEDIMENT.
4. ANY SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC STREETS OR INTO STORM DRAINS MUST BE REMOVED IMMEDIATELY.
5. WHEN APPROPRIATE, WHEELS MUST BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTERING A PUBLIC STREET. WHEN WASHING IS REQUIRED, IT SHALL BE DONE IN AN AREA STABILIZED WITH CRUSHED STONE WHICH DRAINS INTO AN APPROVED SEDIMENT BASIN.

STORMWATER MANUAL

FIGURE 11–5

STAPLE PATTERN FOR STRAW OR EXCELSIOR MATS

(EFFECTIVE DATE 1/01/09)

SLOPES UP TO 1.5H:1V

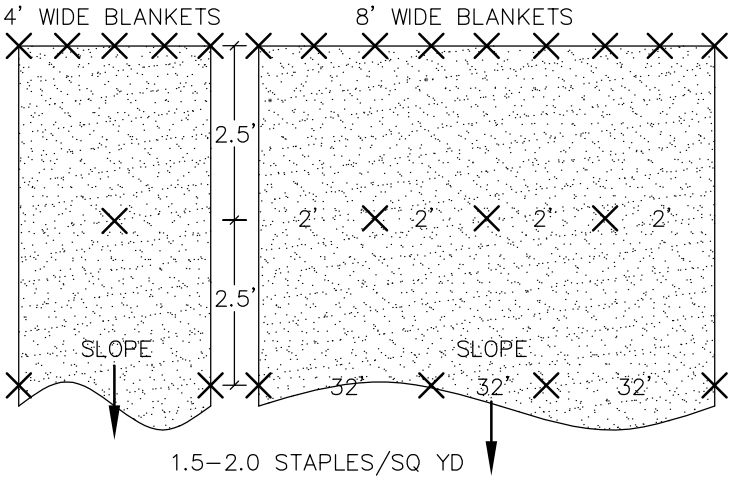
- INSTALL BLANKET VERTICALLY OR HORIZONTALLY
- USE 12" STAPLE SPACING ON STARTER ROW.

COHESIVE SOILS:

- NO OVERLAP REQUIRED ON SIDE SEAMS
- USE 6" STAPLE LENGTH

NON–COHESIVE SOILS:

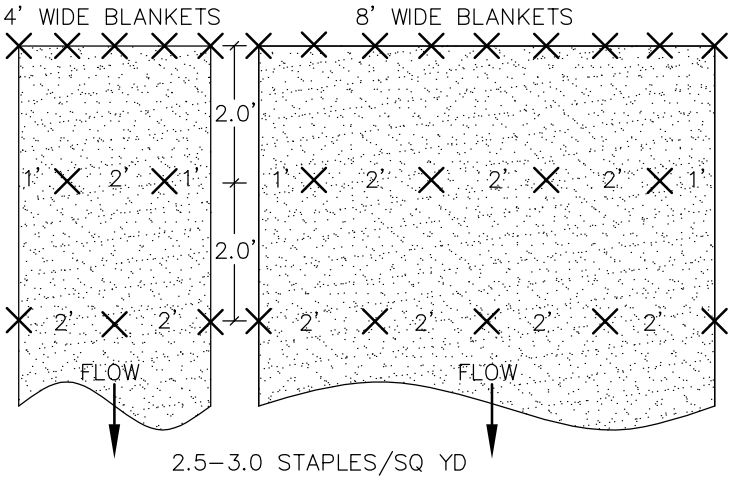
- USE 6" SIDE SEAM OVERLAP
- USE 8" STAPLE LENGTH
- USE 6" ANCHOR TRENCH AT TOP OF SLOPE



1.5–2.0 STAPLES/SQ YD

CHANNELS IN COHESIVE SOILS

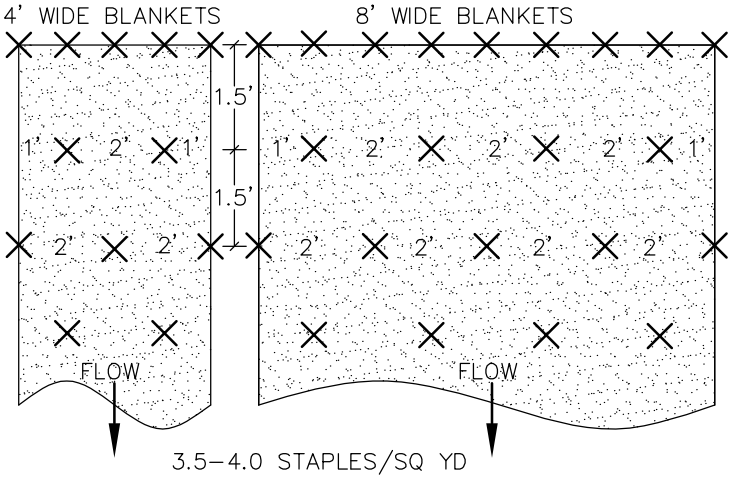
- USE 6" SIDE SEAM OVERLAP
- USE 6" STAPLE LENGTH
- USE 6" TRANSVERSE ANCHOR TRENCH AT 100–FT. INTERVALS
- USE 12" STAPLE SPACING ON STARTER ROW.
- UPSTREAM BLANKET SHOULD OVERLAP DOWNSTREAM BLANKET A DISTANCE OF 12" IN A "SHINGLE" FASHION AND BURY THE FINISHED TOE AT LEAST 6".



2.5–3.0 STAPLES/SQ YD

CHANNELS IN NON–COHESIVE SOILS

- USE 6" SIDE SEAM OVERLAP
- USE 8" STAPLE LENGTH
- USE 6" TRANSVERSE ANCHOR TRENCH AT 50–FT. INTERVALS
- USE 12" STAPLE SPACING ON STARTER ROW.
- UPSTREAM BLANKET SHOULD OVERLAP DOWNSTREAM BLANKET A DISTANCE OF 12" IN A "SHINGLE" FASHION AND BURY THE FINISHED TOE AT LEAST 6".



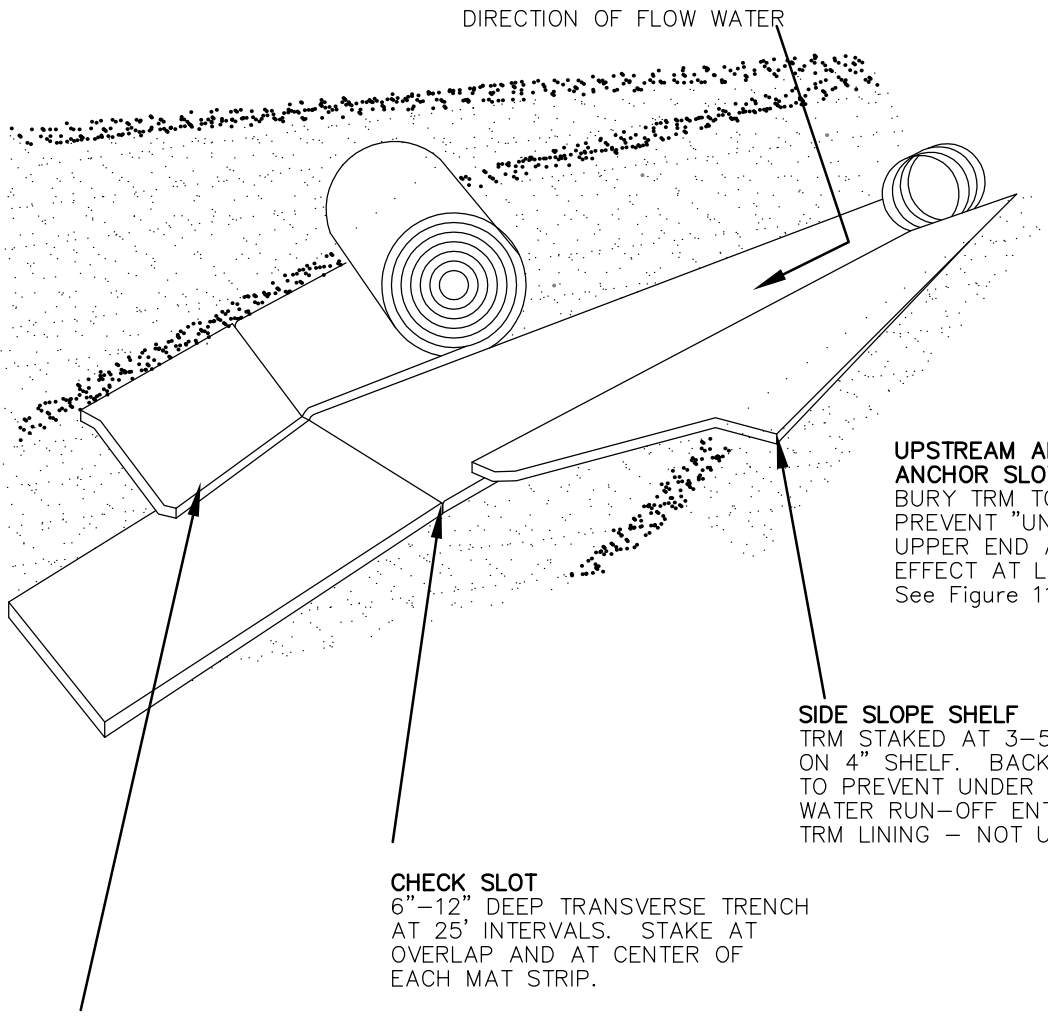
3.5–4.0 STAPLES/SQ YD

STORMWATER MANUAL

FIGURE 11–6

PLACEMENT OF TRM IN CHANNEL

(EFFECTIVE DATE 1/01/09)



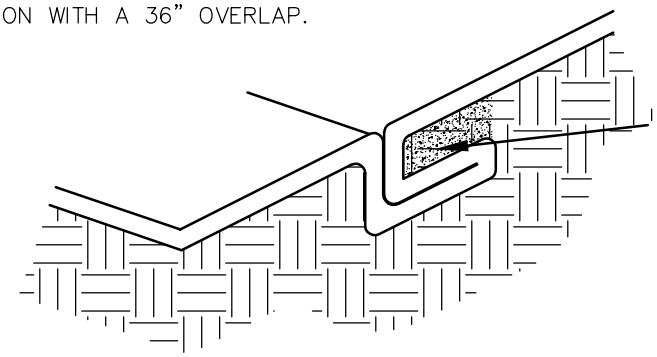
UPSTREAM AND DOWNSTREAM ANCHOR SLOTS
BURY TRM TO 12" DEPTH TO PREVENT "UNDER FLOW" AT UPPER END AND "WATERFALL" EFFECT AT LOWER END.
See Figure 11–7

SIDE SLOPE SHELF
TRM STAKED AT 3–5' INTERVALS ON 4" SHELF. BACK FILL AND TAMP TO PREVENT UNDER WASHING. WATER RUN–OFF ENTERS ONTO TRM LINING – NOT UNDER IT.

CHECK SLOT
6"–12" DEEP TRANSVERSE TRENCH AT 25' INTERVALS. STAKE AT OVERLAP AND AT CENTER OF EACH MAT STRIP.

OVERLAP IN A SHINGLE FASHION
4" OVERLAP STAKED AT 3–5' INTERVALS

WHEN ROLL TERMINATES, IT IS STAKED OVER THE ROLL WHICH EXTENDS DOWNSTREAM IN A SHINGLE FASHION WITH A 36" OVERLAP.



CHECK SLOT DETAIL
STAKE AND BACK FILL IN CHECK SLOT BEFORE CONTINUING TO PLACE UPSLOPE

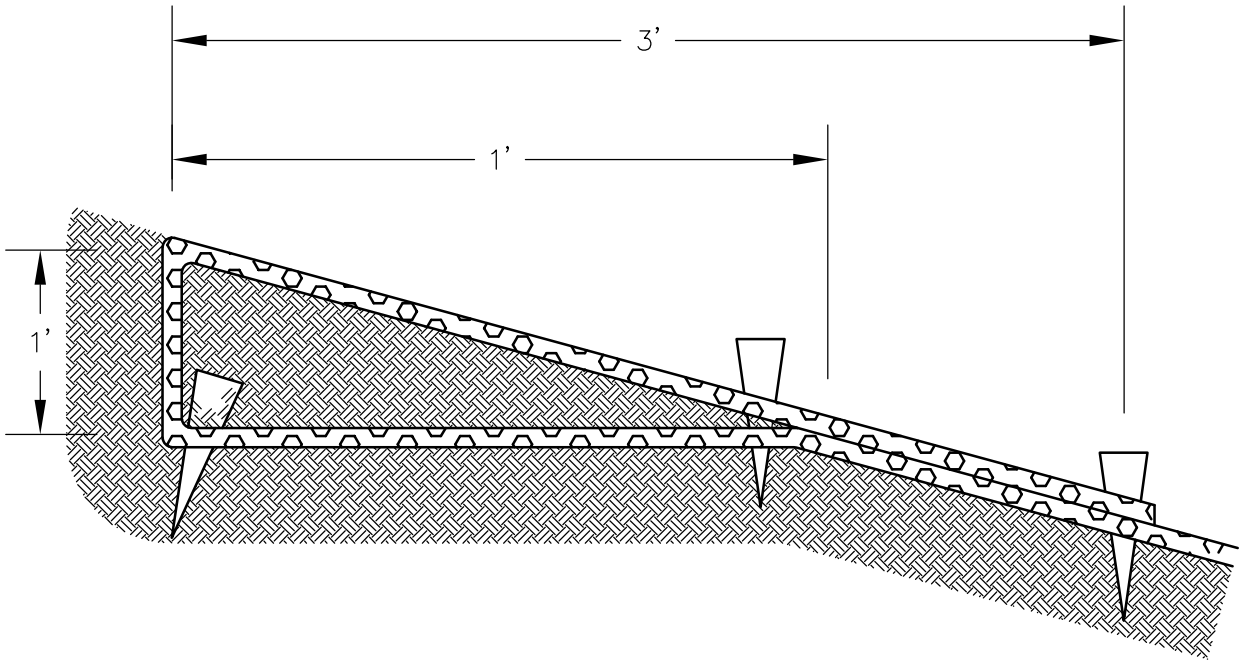
STORMWATER MANUAL

FIGURE 11-7

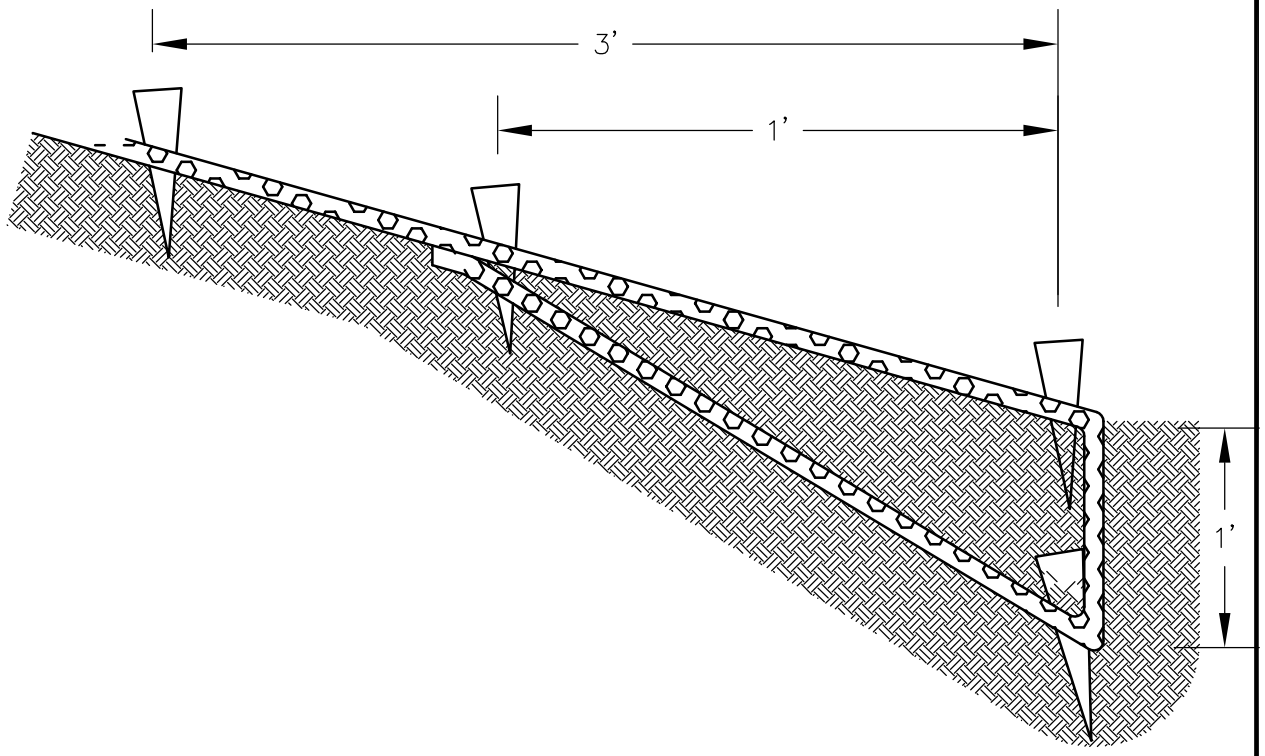
ANCHOR SLOT DETAILS FOR TRM

(EFFECTIVE DATE 1/01/09)

UPSTREAM ANCHOR SLOT DETAIL



DOWNSTREAM ANCHOR SLOT DETAIL

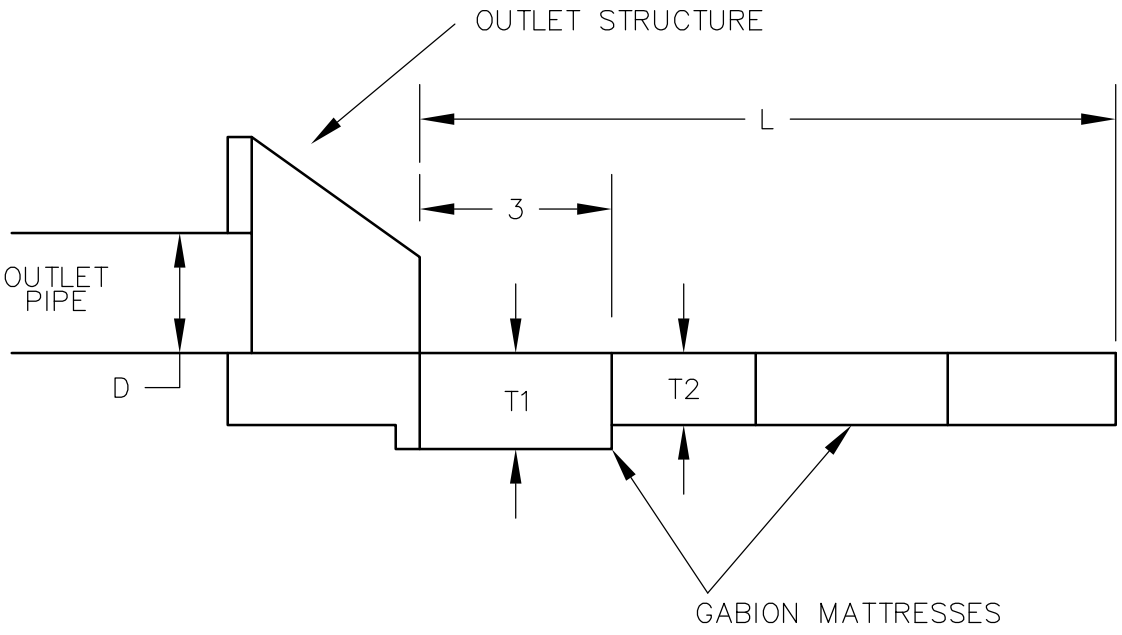


STORMWATER MANUAL

FIGURE 11-8

CROSS SECTION AT
GABION MATTRESS OUTLET PROTECTION

(EFFECTIVE DATE 1/01/09)



T1 = THICKNESS OF FIRST 3 FEET OF GABION MATTRESS TO MATCH DEPTH OF OUTLET STRUCTURE FOUNDATION

T2 = THICKNESS OF REMAINING GABION MATTRESS, 12 INCHES MINIMUM AND 18 INCHES MINIMUM FOR CALCULATED OUTLET VELOCITIES OF 10 TO 15 FEET PER SECOND.

FOR D < 36 INCHES, L = 12 FEET

FOR D > 36 INCHES, L = 4 x D FEET

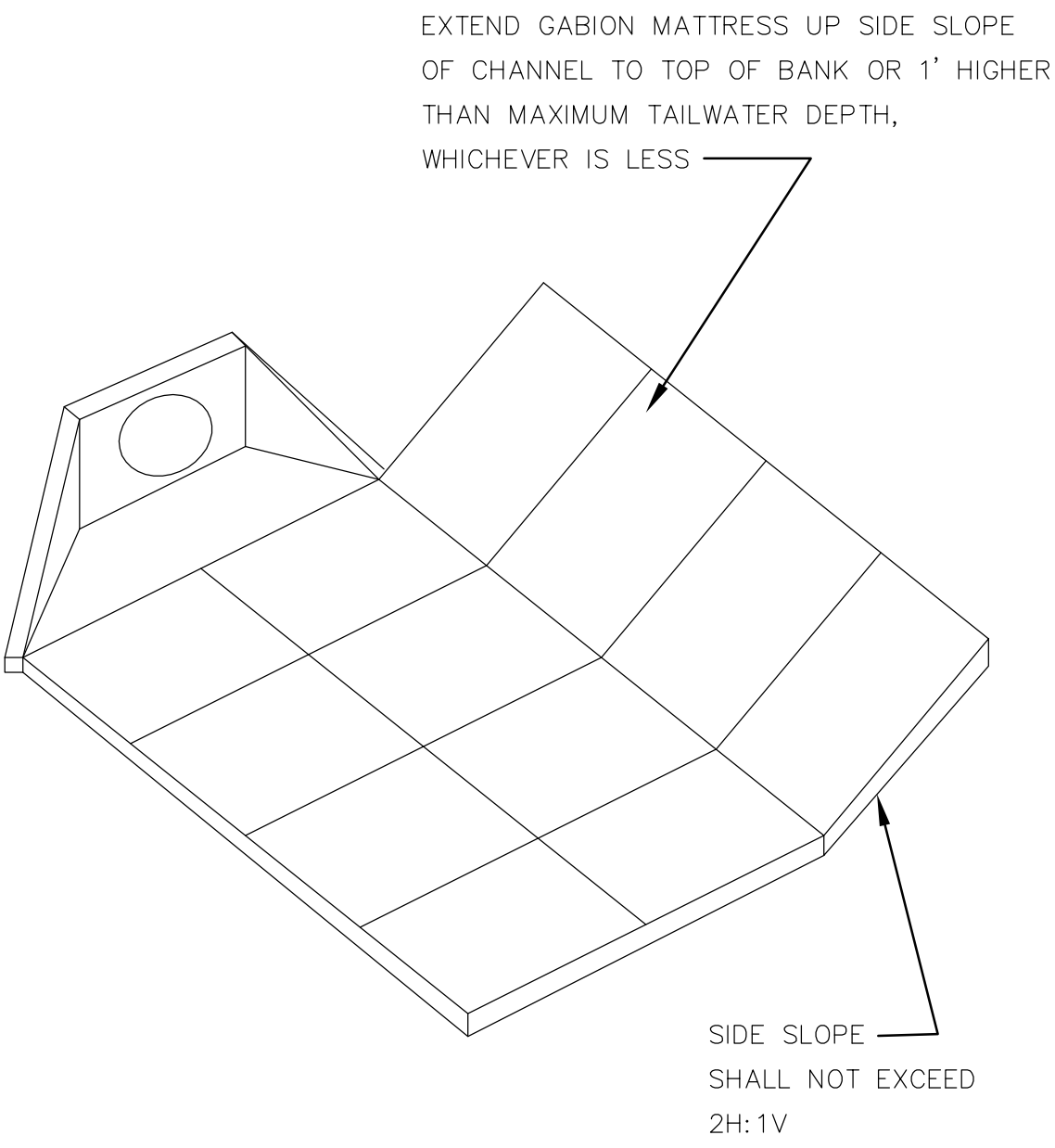
D = HEIGHT OR WIDTH OF OUTLET, WHICHEVER IS GREATER

STORMWATER MANUAL

FIGURE 11-9

GABION MATTRESS AT OUTLET
INTO WELL-DEFINED CHANNEL

(EFFECTIVE DATE 1/01/09)

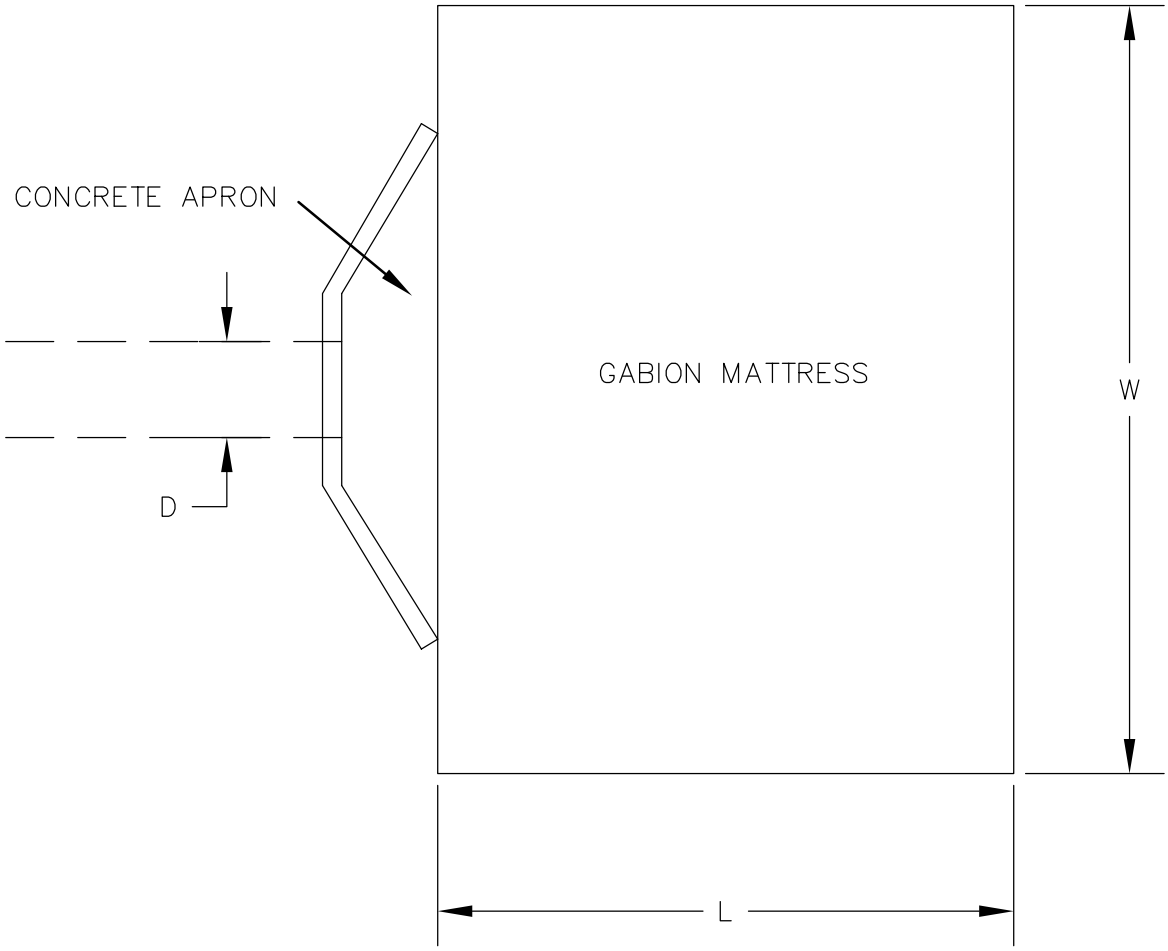


STORMWATER MANUAL

FIGURE 11–10

PLAN VIEW OF GABION MATTRESS AT OUTLET INTO FLAT AREA

(EFFECTIVE DATE 1/01/09)



D = HEIGHT OR WIDTH OF OUTLET, WHICHEVER IS GREATER

FOR D <= 36 INCHES:

L = 12 FEET MINIMUM

W = (18 + D) FEET MINIMUM

FOR D > 36 INCHES:

L = 4 x D FEET MINIMUM

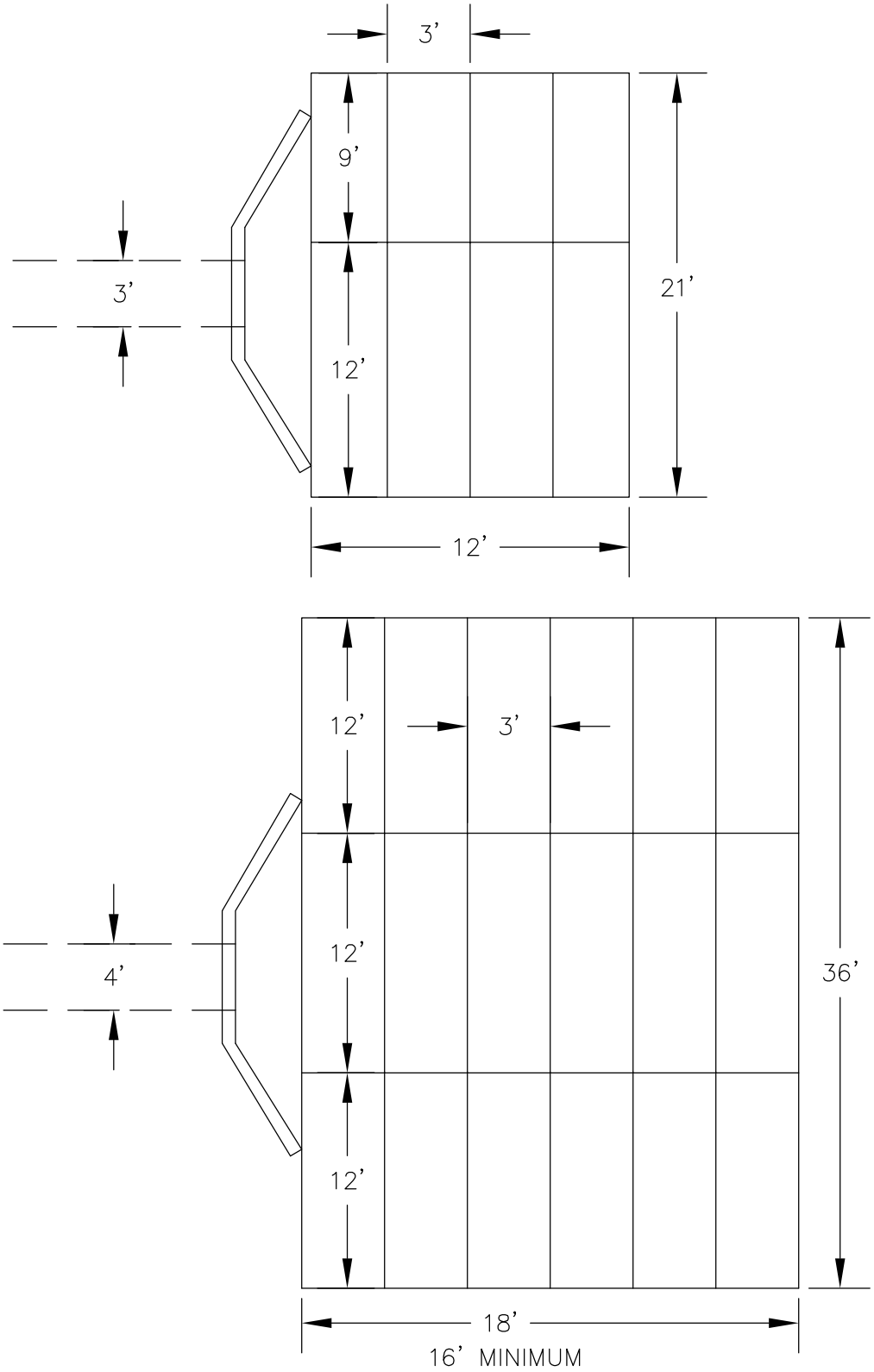
W = (2 L + D) FEET MINIMUM

STORMWATER MANUAL

FIGURE 11–11

EXAMPLE PLAN VIEW LAYOUTS OF GABION MATTRESS FOR OUTLET ONTO FLAT AREAS

(EFFECTIVE DATE 1/01/09)

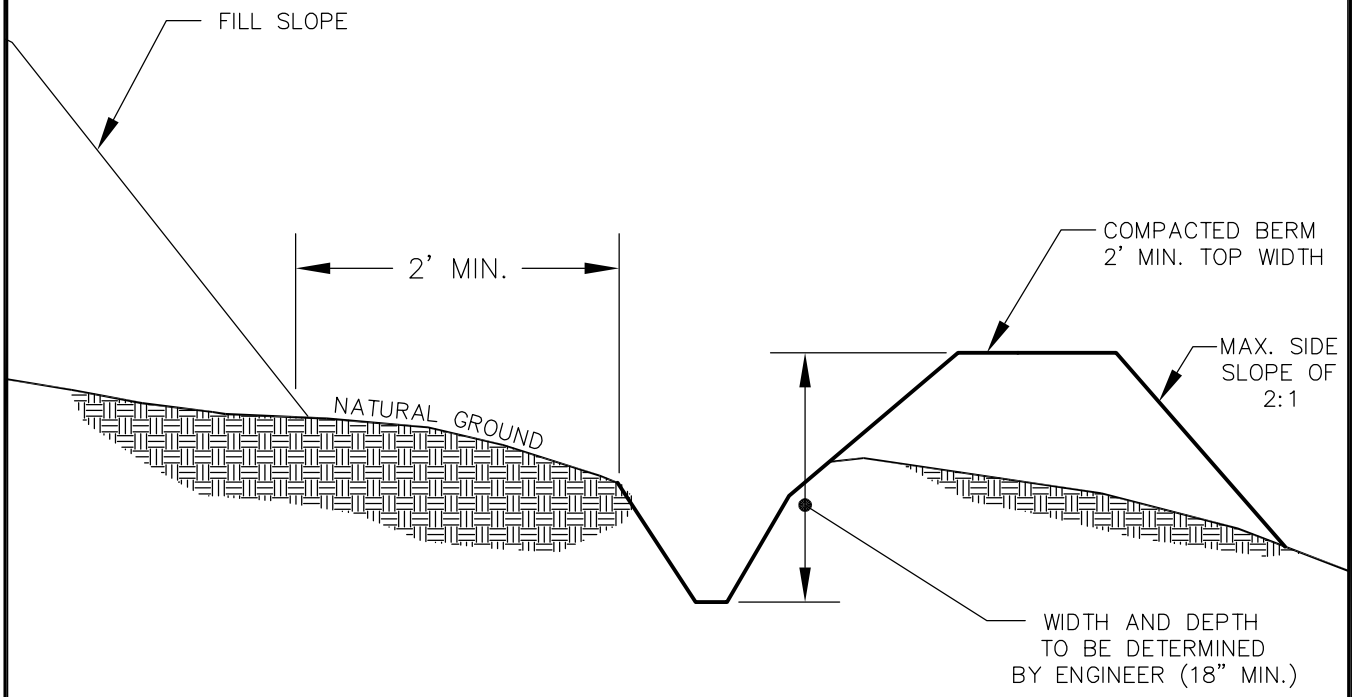


STORMWATER MANUAL

FIGURE 11–12

TEMPORARY DIVERSION DITCH

(EFFECTIVE DATE 1/01/09)

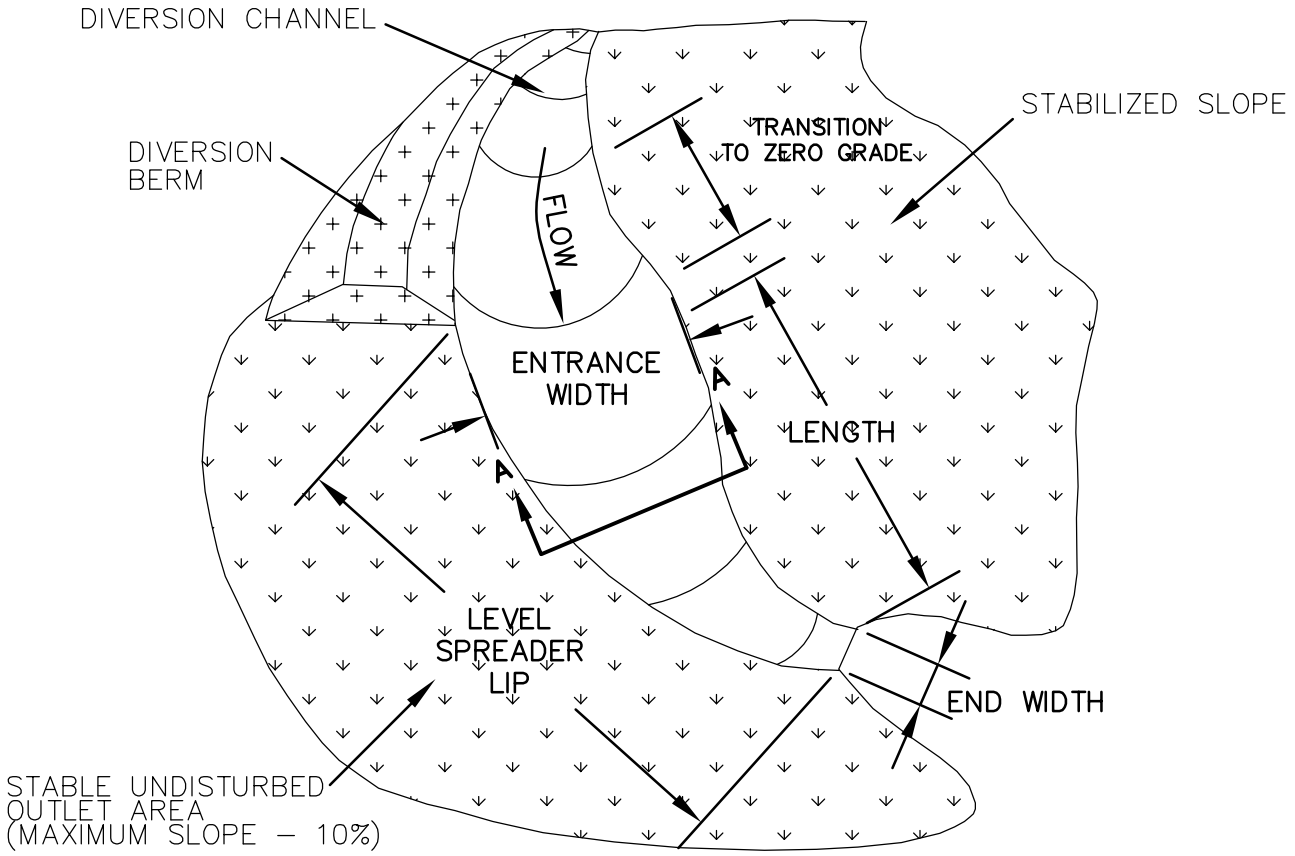


STORMWATER MANUAL

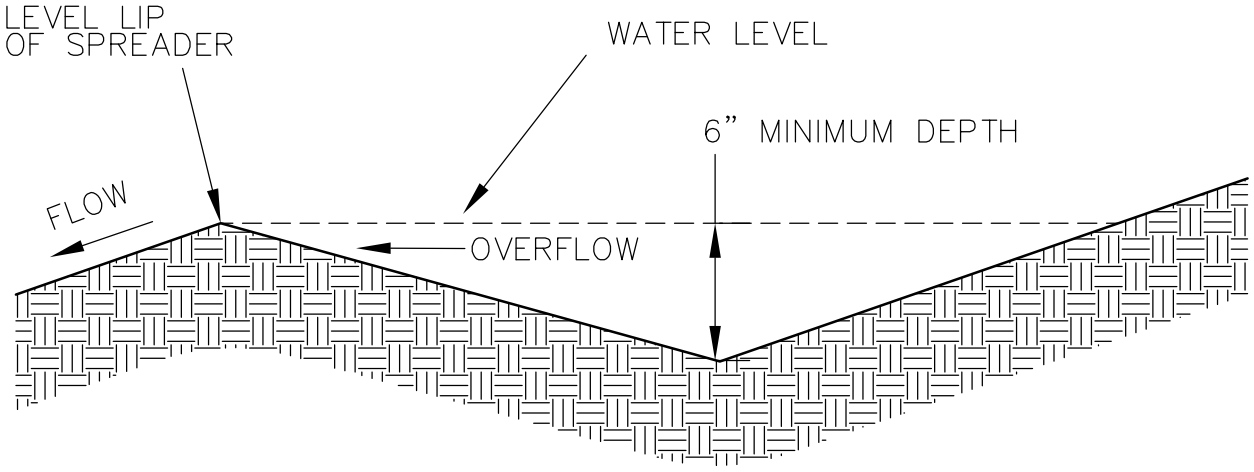
FIGURE 11–13

LEVEL SPREADER

(EFFECTIVE DATE 1/01/09)



PERSPECTIVE



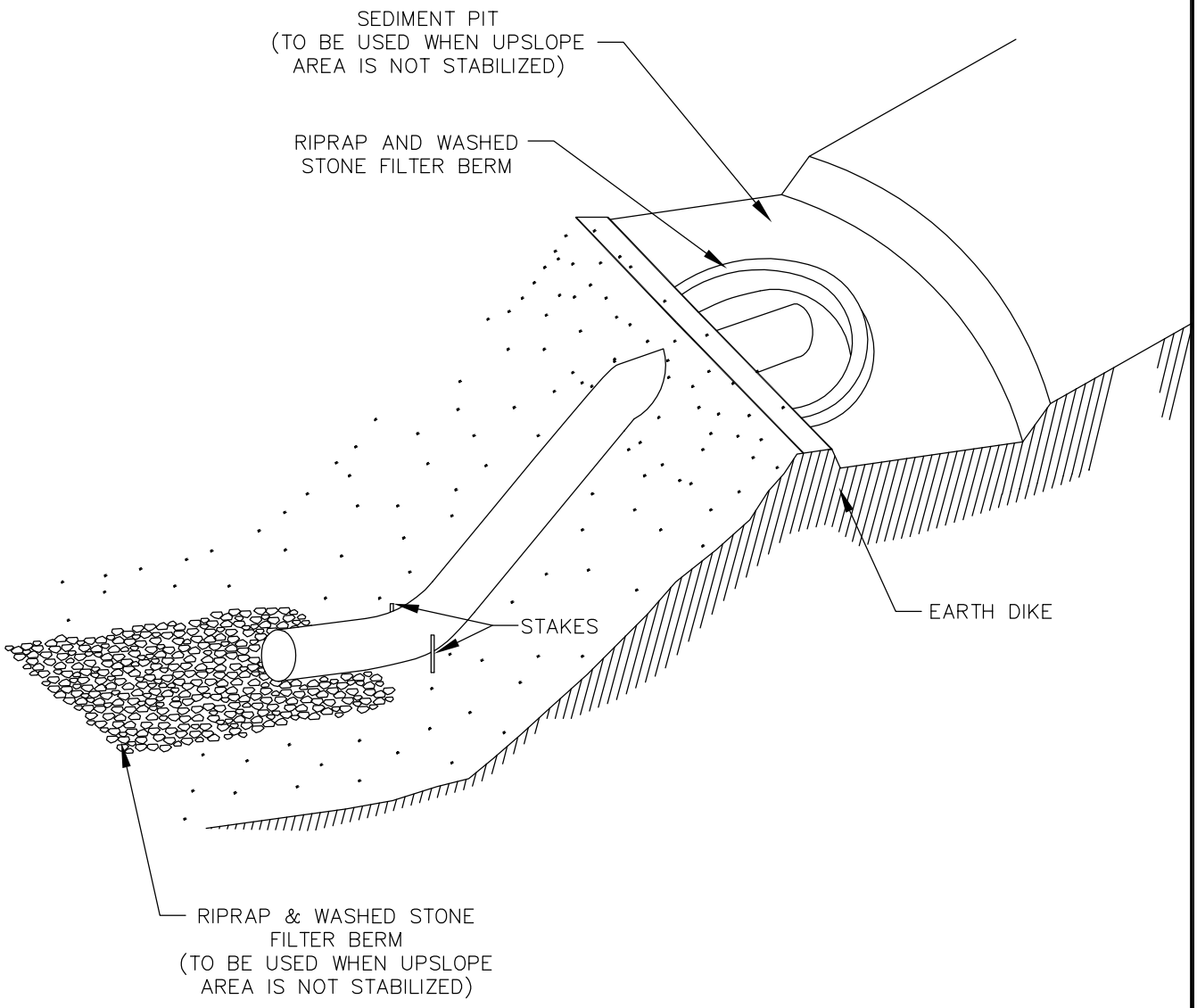
SECTION A–A

STORMWATER MANUAL

FIGURE 11–14

FLEXIBLE PIPE SLOPE DRAIN

(EFFECTIVE DATE 1/01/09)

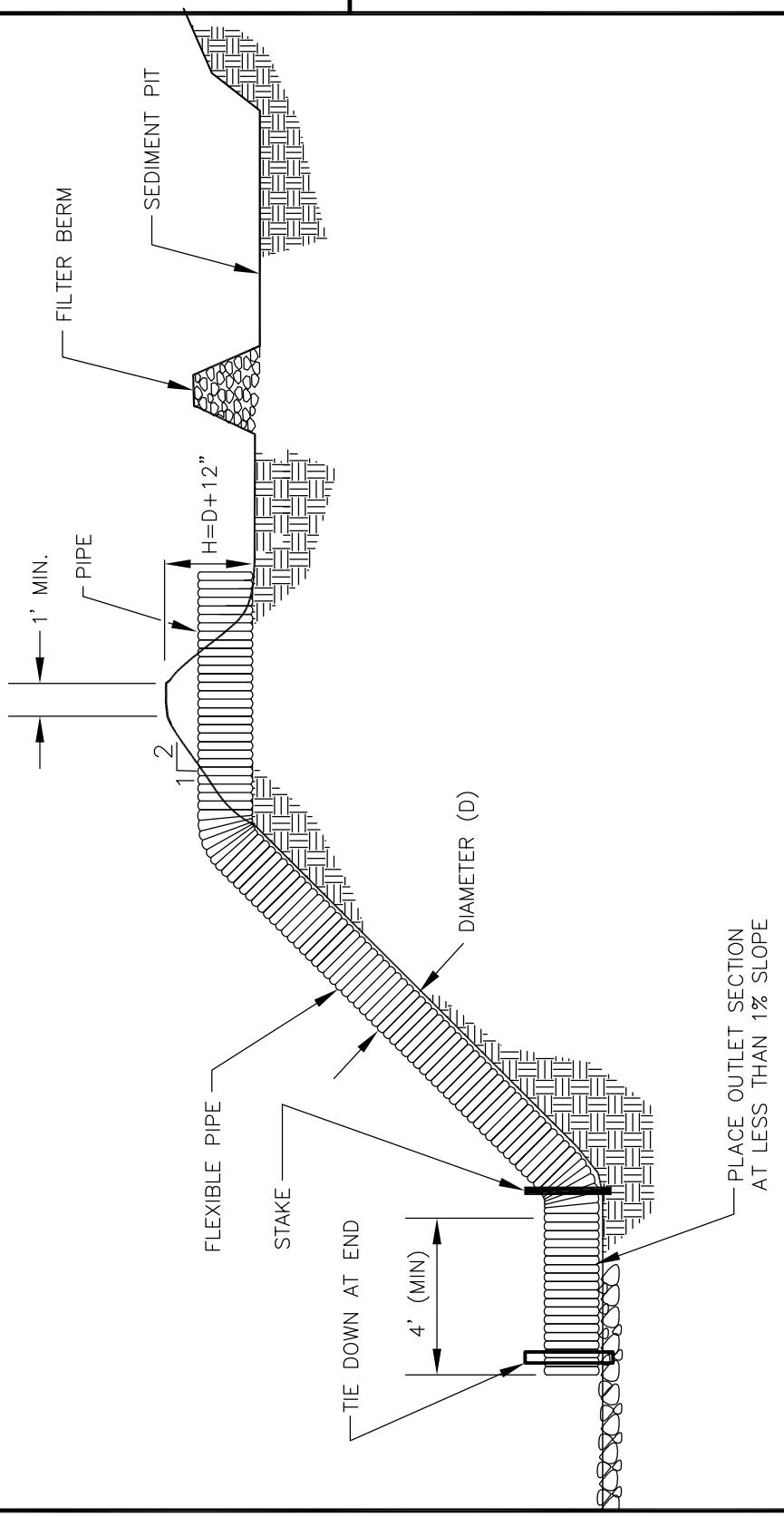


STORMWATER MANUAL

FIGURE 11–15

SLOPE DRAIN – PROFILE

(EFFECTIVE DATE 1/01/09)

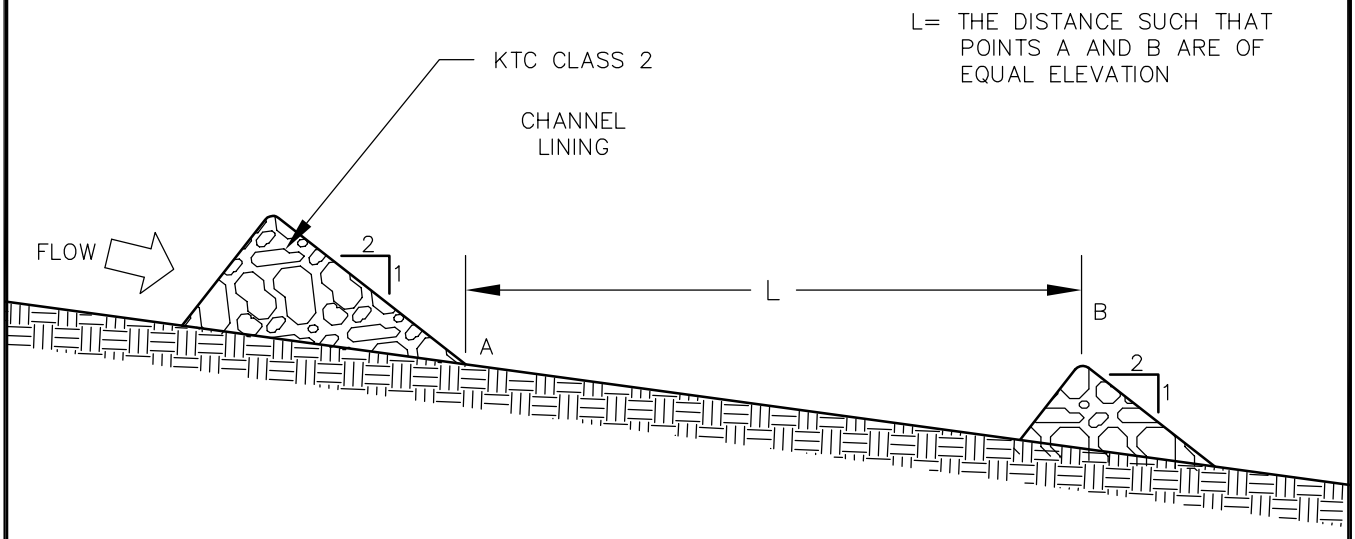


STORMWATER MANUAL

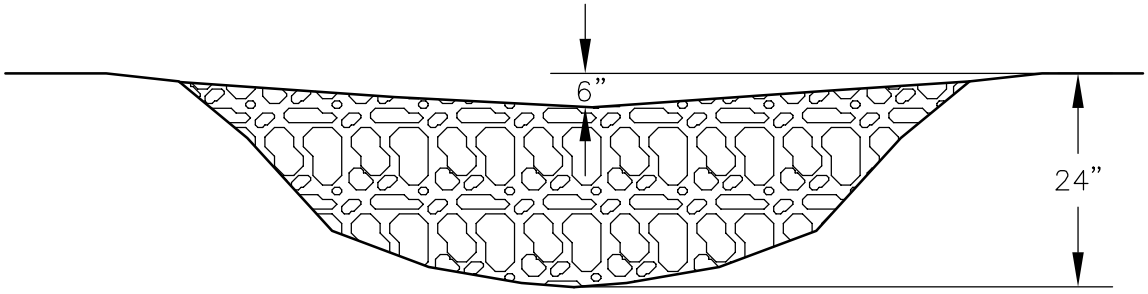
FIGURE 11–16

ROCK CHECK DAM

(EFFECTIVE DATE 1/01/09)



LONGITUDINAL SECTION SHOWING SPACING BETWEEN CHECK DAMS



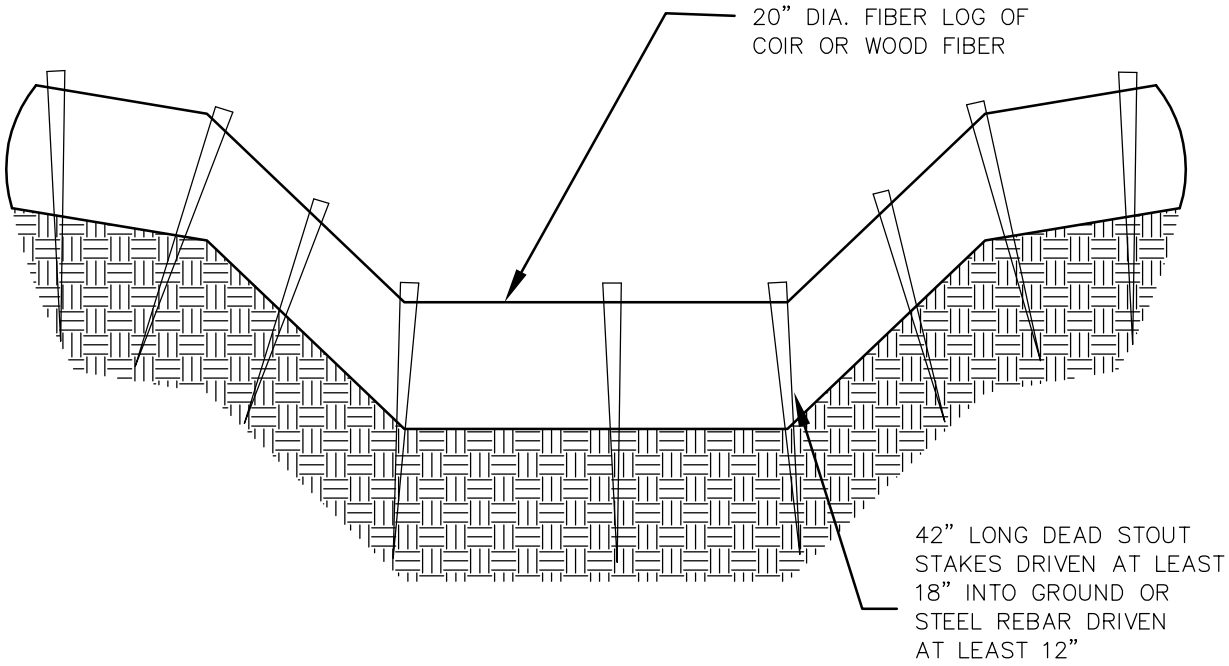
SECTION ACROSS CHANNEL

STORMWATER MANUAL

FIGURE 11–17

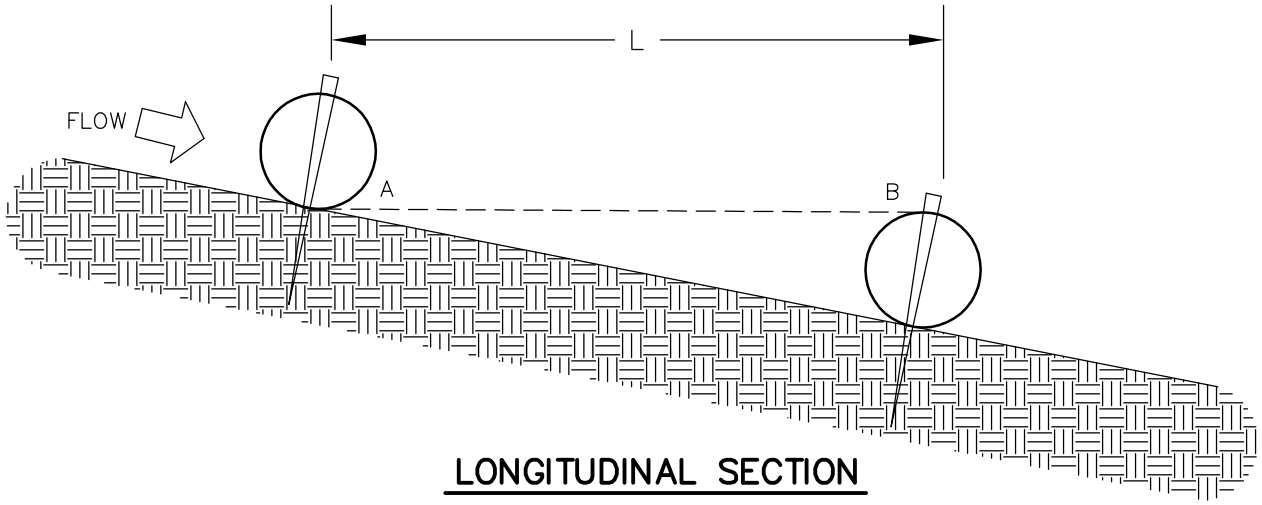
FIBER LOG CHECK DAM

(EFFECTIVE DATE 1/01/09)



SECTION ACROSS CHANNEL

STAKES SHALL BE SPACED NO FURTHER
THAN 24" AND SHALL BE DRIVEN AT EACH
SIGNIFICANT SLOPE BREAK AND WITHIN 6" OF EACH END.



LONGITUDINAL SECTION

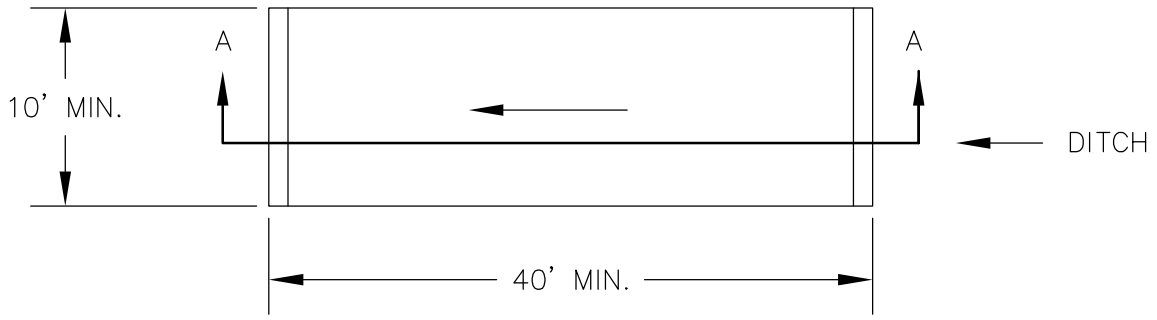
L = DISTANCE SUCH THAT POINTS A AND B ARE OF EQUAL ELEVATION

STORMWATER MANUAL

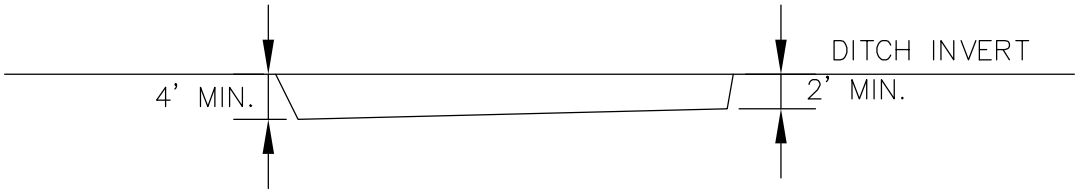
FIGURE 11–18

SEDIMENT TRAP

(EFFECTIVE DATE 1/01/09)



PLAN VIEW



SECTION A–A

NOTES:

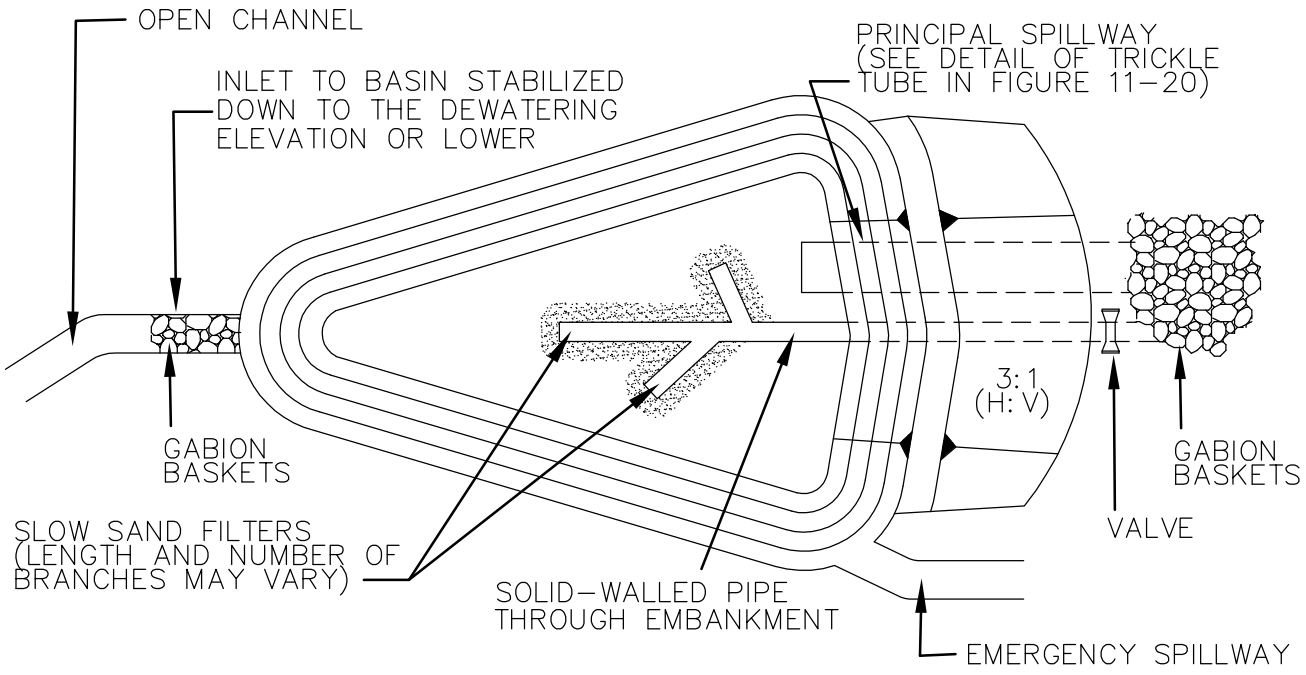
1) THE SIZE, SHAPE AND LOCATION OF TRAP MAY BE ADJUSTED FROM THAT SHOWN IN THE CONSTRUCTION PLANS, AS DIRECTED BY THE ENGINEER.
2) THE SEDIMENT TRAP MAY BE CONSTRUCTED AS DIRECTED BY THE ENGINEER AS LONG AS THE AREA AND DEPTH IS AT LEAST AS THAT INDICATED ON THE PLANS.
3) SEDIMENT TRAP SHALL BE CONSTRUCTED BY EXCAVATING THE BASIN IN NATURAL OR EXCAVATED CHANNELS. SEDIMENT DEPOSITS IN TRAP SHALL BE REMOVED EACH TIME THE TRAP IS APPROXIMATELY 50 PERCENT FILLED. WHEN THEIR USEFULNESS HAS ENDED, THE TRAPS SHALL BE REMOVED, SURPLUS MATERIAL DISPOSED OF AND THE ENTIRE DISTURBED AREA SHALL BE SEEDED AND PROTECTED, OR SODDED, AS DIRECTED. SEDIMENT TRAPS MAY REMAIN IN PLACE UPON COMPLETION OF THE PROJECT ONLY WHEN PERMITTED BY THE ENGINEER OR THE PLANS.

STORMWATER MANUAL

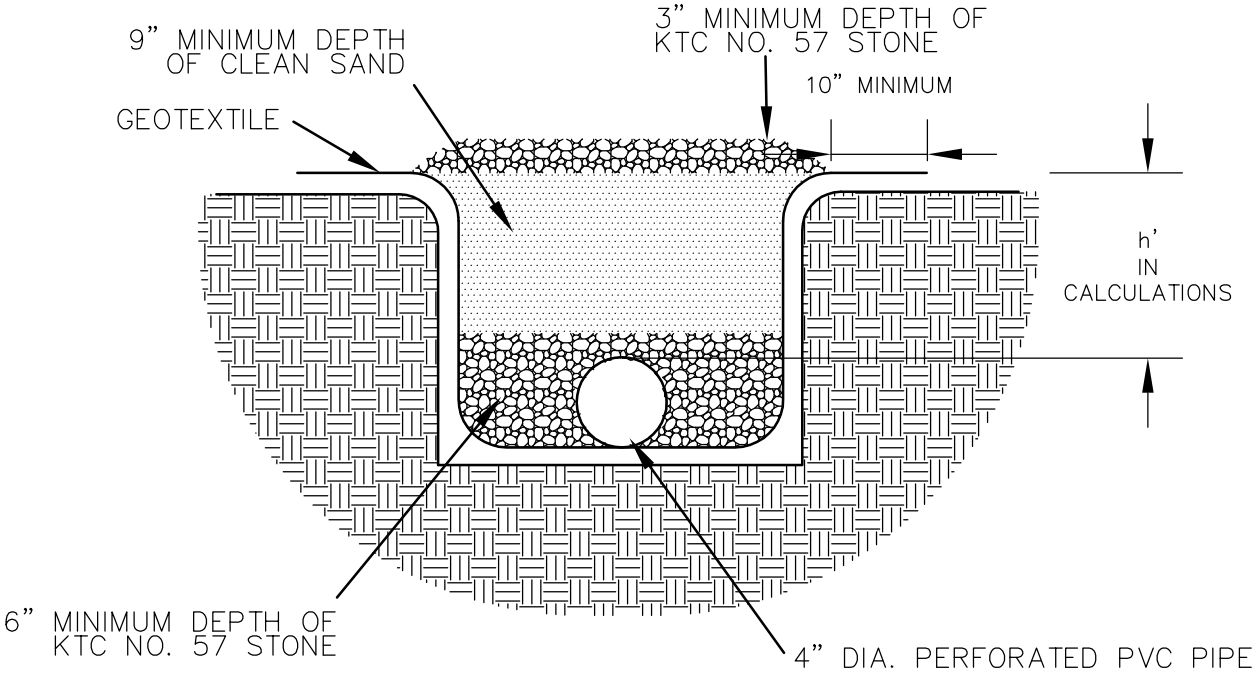
FIGURE 11–19

SEDIMENT POND WITH
SAND FILTER OUTLET

(EFFECTIVE DATE 1/01/09)



PLAN VIEW
N.T.S.



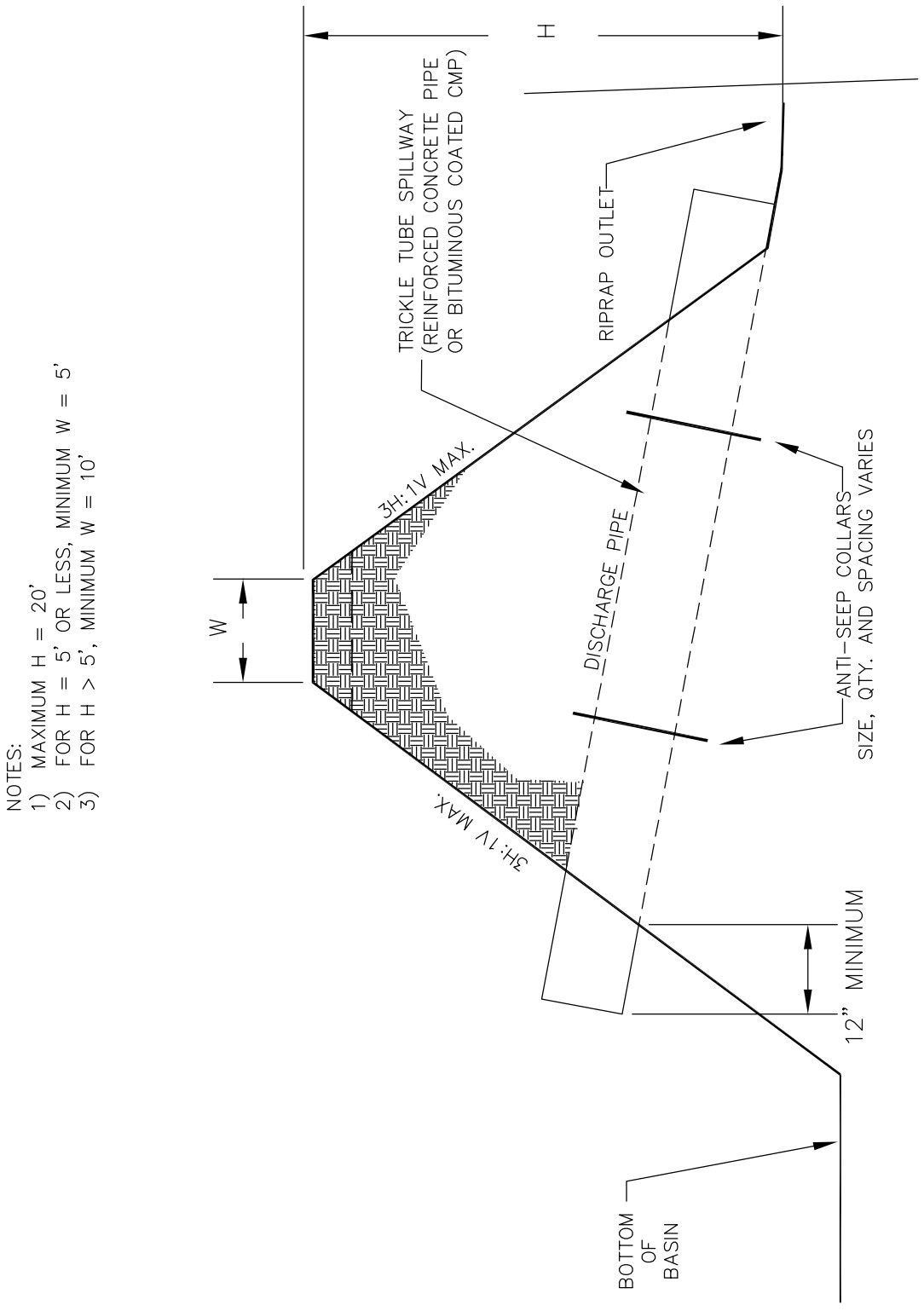
TYPICAL SECTION
N.T.S.

STORMWATER MANUAL

FIGURE 11–20

SEDIMENT POND PRINCIPAL SPILLWAY DETAIL

(EFFECTIVE DATE 1/01/09)



TYPICAL SECTION

N.T.S.

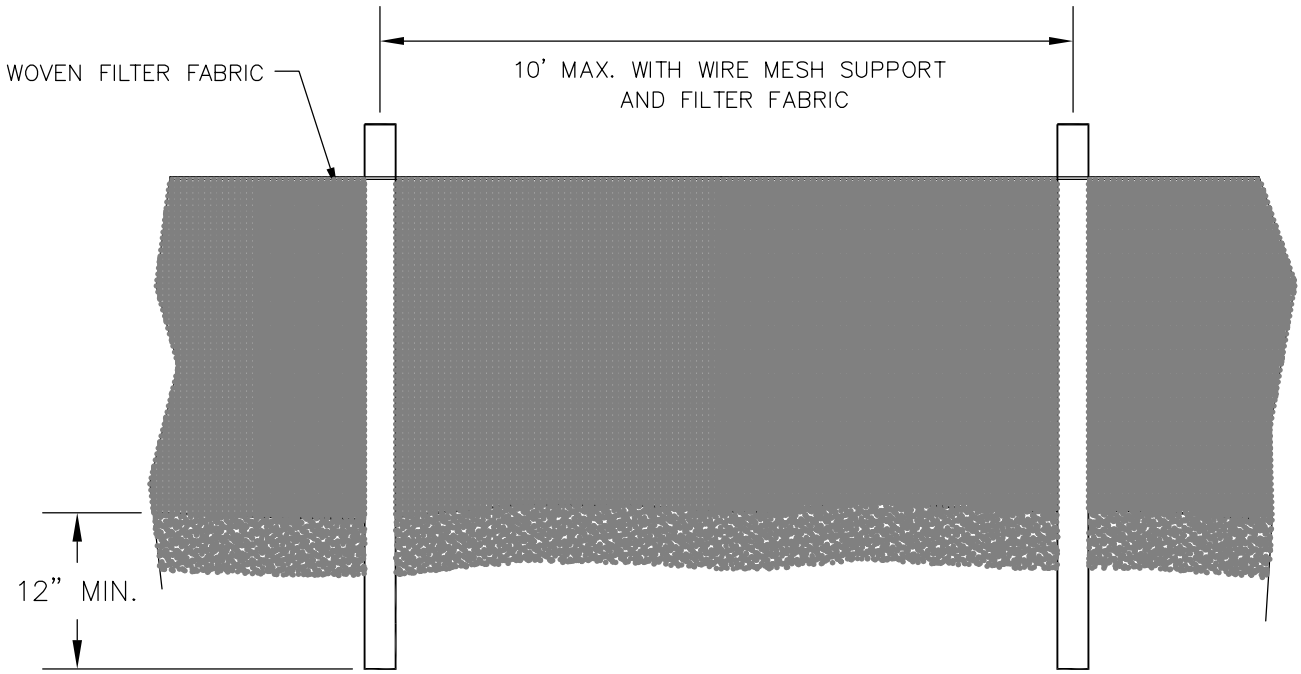
NOTES:
1) MAXIMUM H = 20'
2) FOR H = 5' OR LESS, MINIMUM W = 5'
3) FOR H > 5', MINIMUM W = 10'

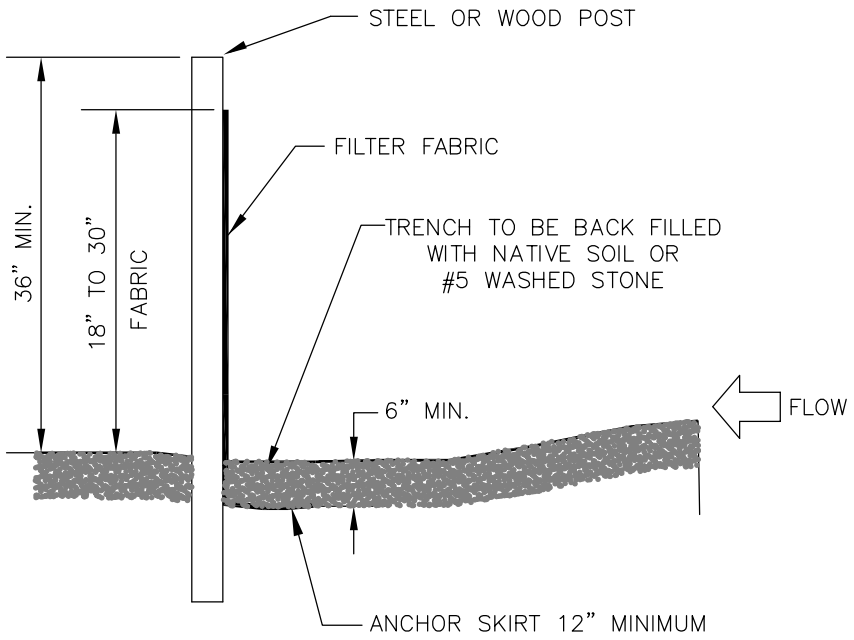
STORMWATER MANUAL

FIGURE 11–21

TEMPORARY SILT FENCE

(EFFECTIVE DATE 1/01/09)





STORMWATER MANUAL

FIGURE 11-22

TEMPORARY SILT FENCE
GENERAL NOTES

(EFFECTIVE DATE 1/01/09)

GENERAL NOTES

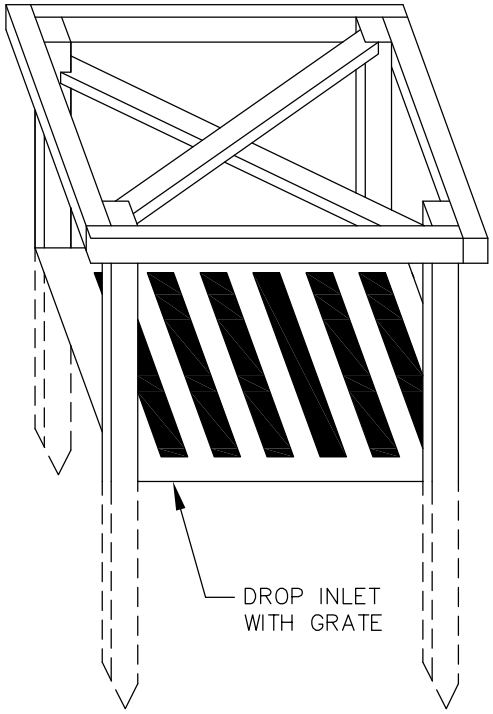
1. FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL AND CUT TO THE LENGTH OF THE BARRIER. WHEN JOINTS CANNOT BE AVOIDED, FILTER FABRIC SHALL BE SPLICED TOGETHER ONLY AT A POST WITH 3 FOOT MIN. OVERLAP, AND SECURELY SEALED.
2. POSTS SHALL BE SPACED AT 6 FOOT INTERVALS IN AREAS OF RAPID RUNOFF.
3. POSTS SHALL BE AT LEAST 5 FEET IN LENGTH.
4. STEEL POSTS SHALL HAVE PROJECTIONS FOR FASTENING WIRE AND FABRIC.
5. WOOD POSTS SHALL BE 2 INCHES BY 2 INCHES OR EQUIVALENT. STEEL POSTS SHALL BE 1.33 LBS PER LINEAR FOOT.
6. A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH IN LENGTH, WIRE TIES OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 2 INCHES AND SHALL NOT EXTEND MORE THAN 36 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
7. WASHED STONE SHALL BE USED TO BURY SKIRT WHEN SILT FENCE IS USED ADJACENT TO A CHANNEL, CREEK, OR POND.
8. TURN SILT FENCE UP SLOPE AT ENDS.

STORMWATER MANUAL

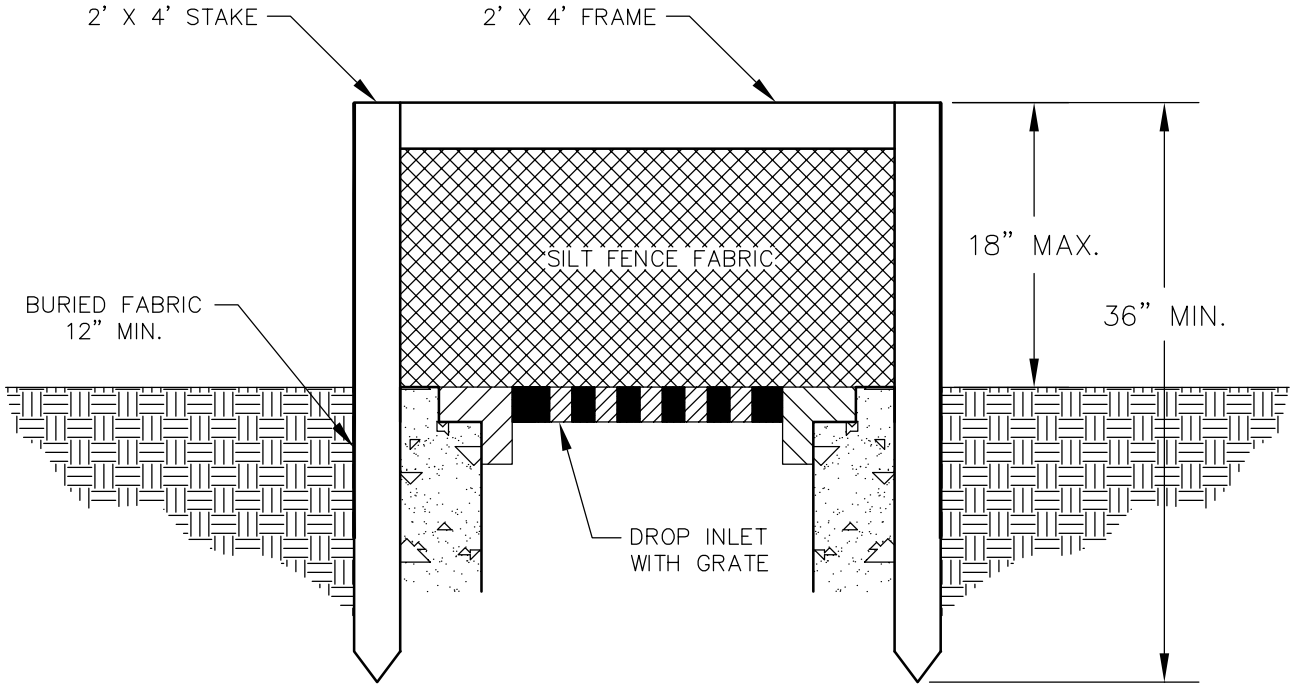
FIGURE 11-23

DROP INLET PROTECTION
USING SILT FENCE

(EFFECTIVE DATE 1/01/09)



ISOMETRIC VIEW OF
2 X 4 WOOD FRAME



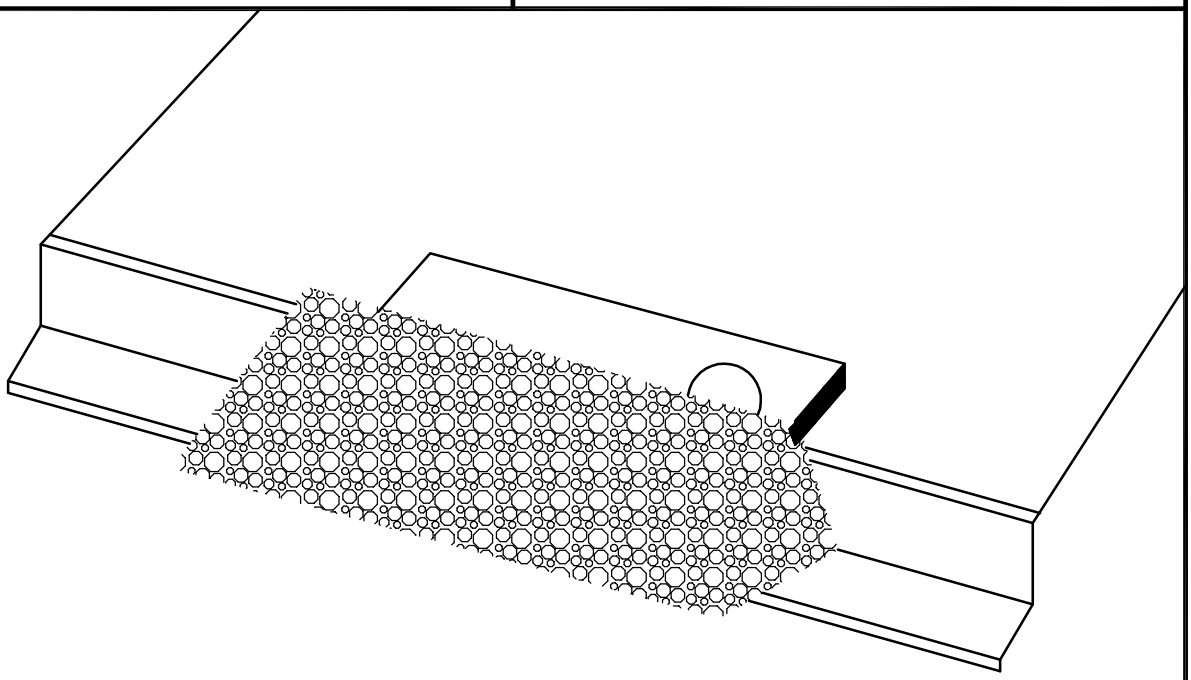
CROSS SECTION VIEW

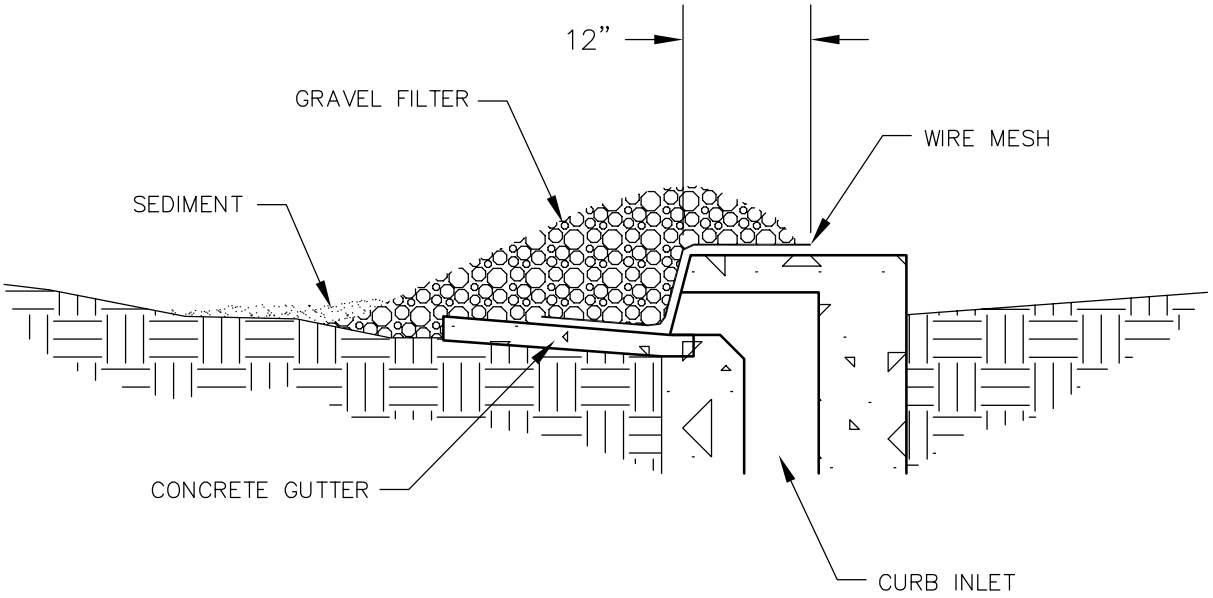
STORMWATER MANUAL

FIGURE 11–24

GRAVEL CURB INLET SEDIMENT FILTER

(EFFECTIVE DATE 1/01/09)



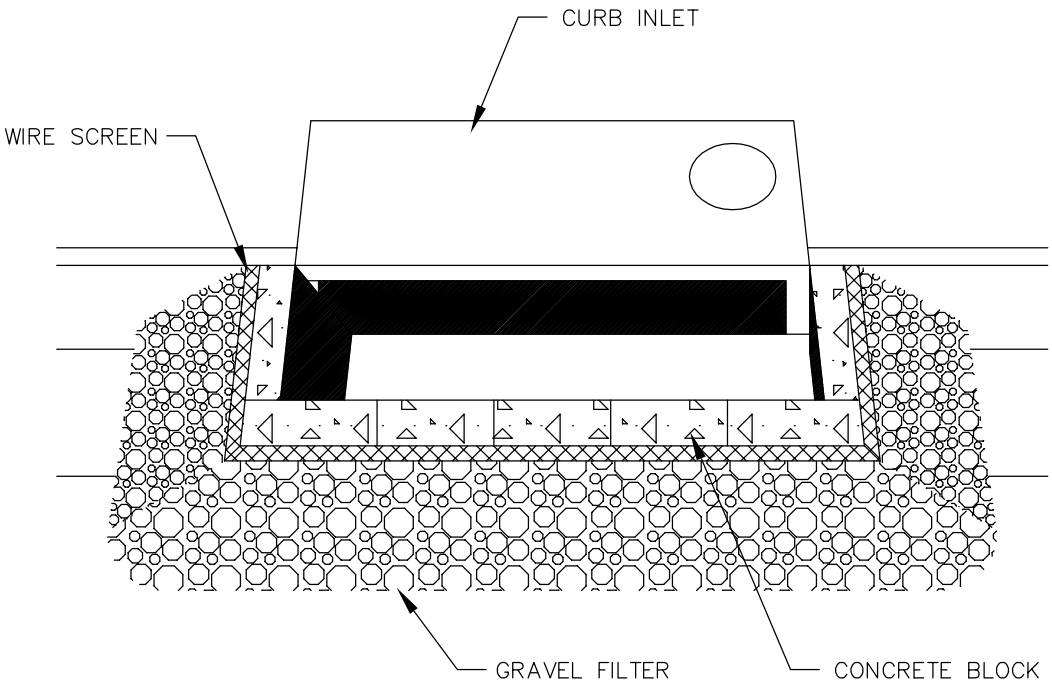


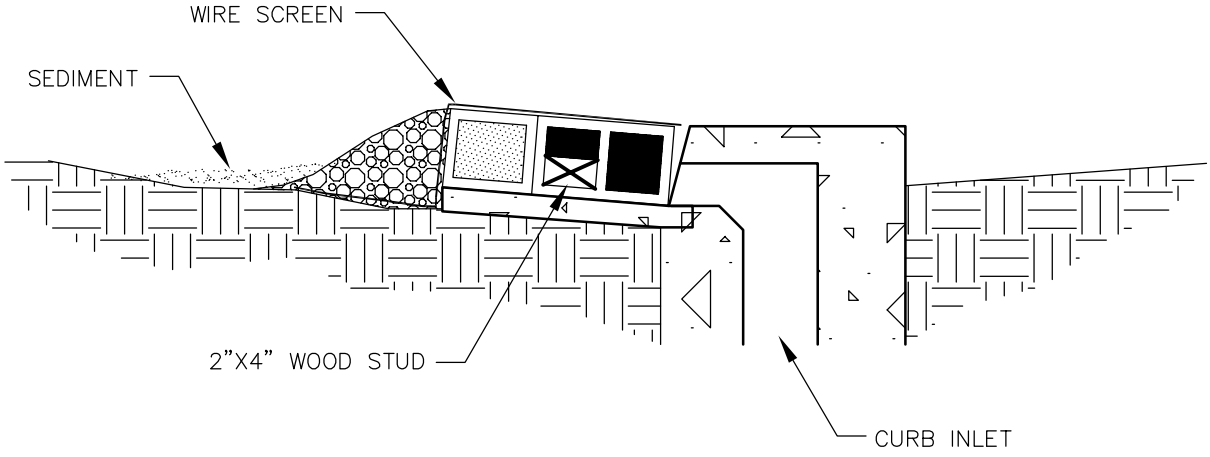
STORMWATER MANUAL

FIGURE 11–25

BLOCK AND GRAVEL CURB INLET SEDIMENT FILTER

(EFFECTIVE DATE 1/01/09)



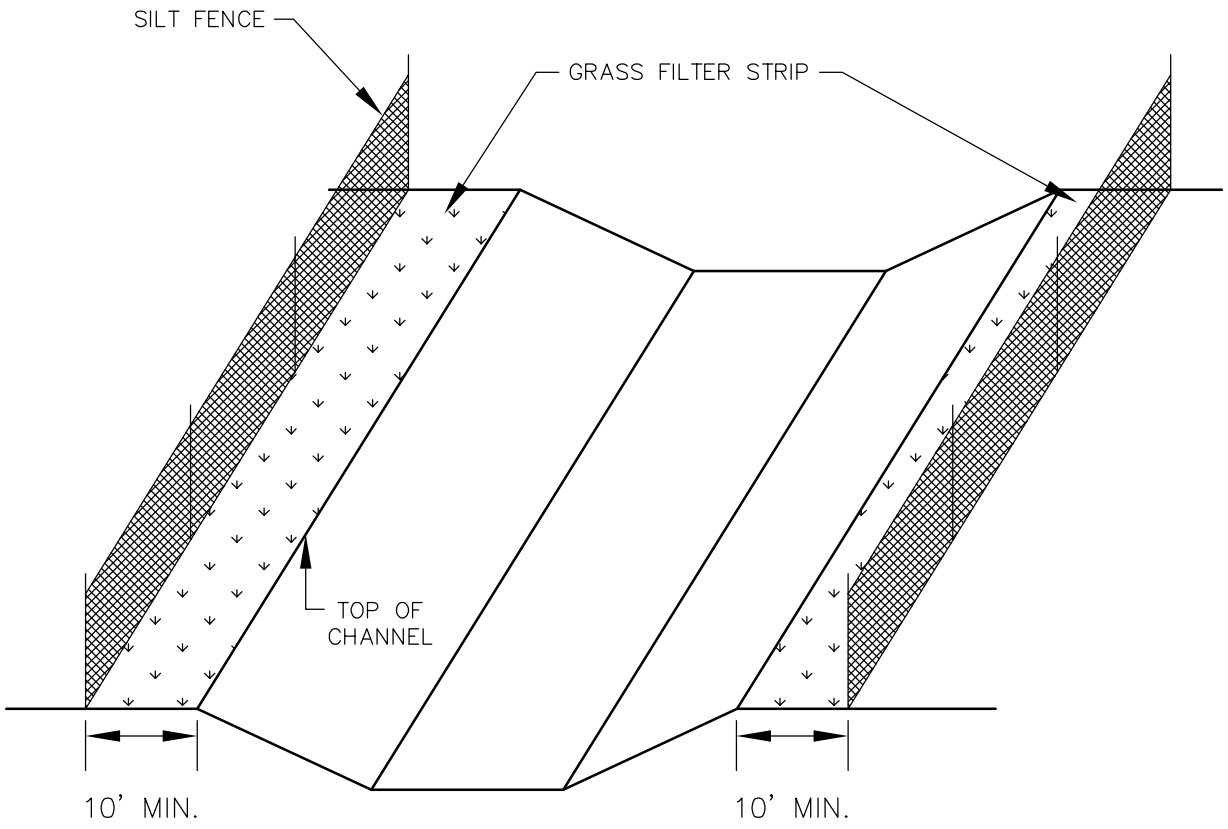


STORMWATER MANUAL

FIGURE 11–26

FILTER STRIP FOR
CONSTRUCTED CHANNEL

(EFFECTIVE DATE 1/01/09)

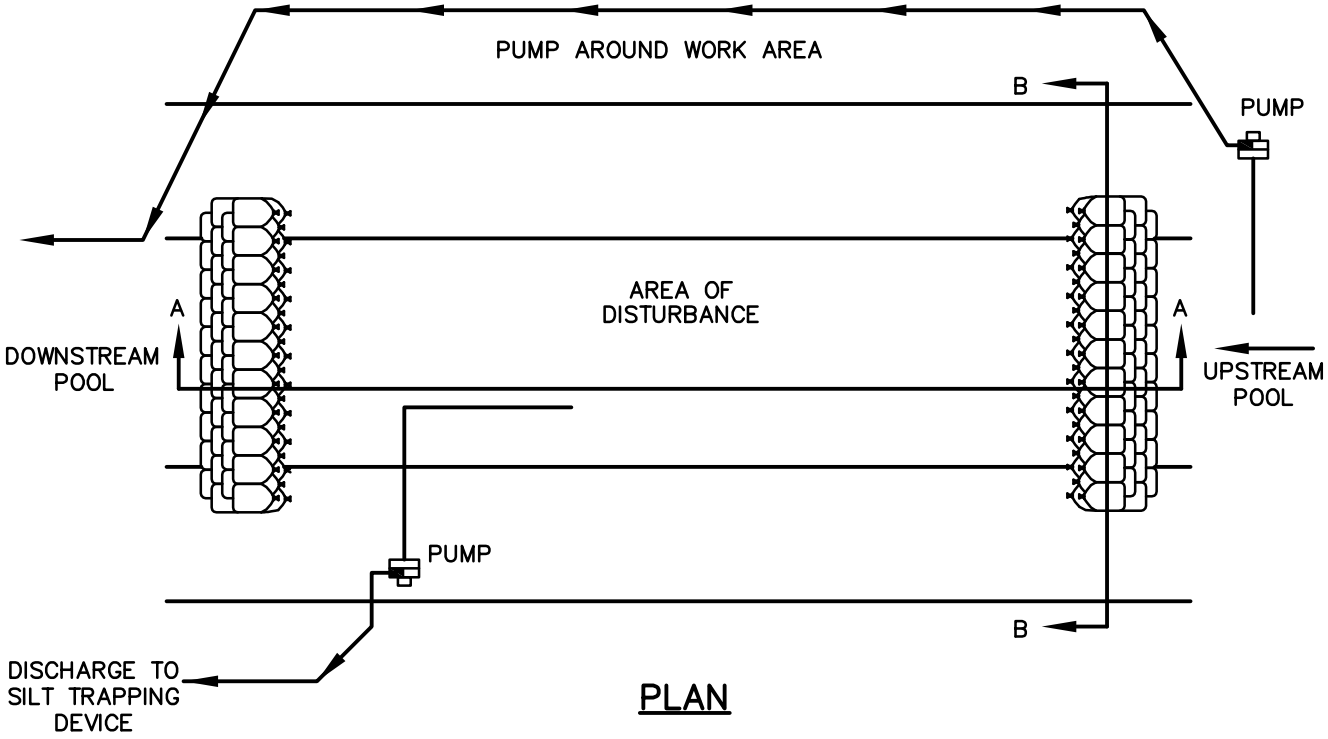


STORMWATER MANUAL

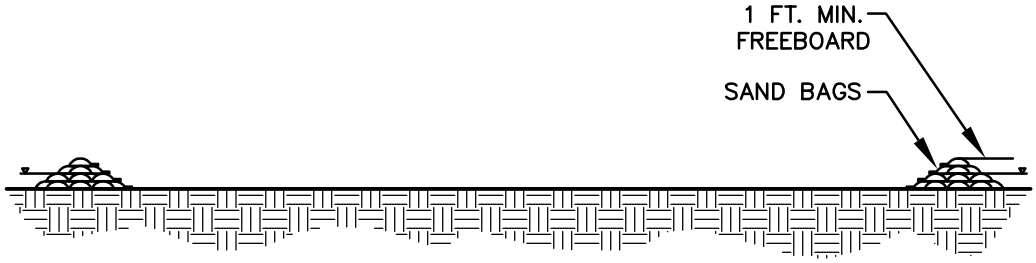
FIGURE 11-27

PUMP-AROUND FLOW DIVERSION

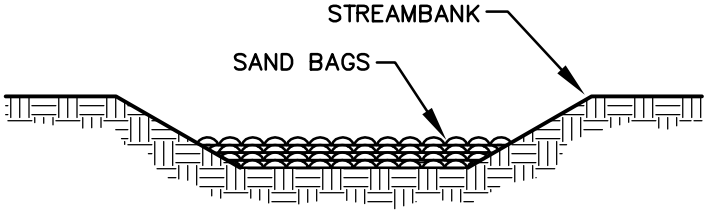
(EFFECTIVE DATE 1/01/09)



PLAN



SECTION A-A



SECTION B-B